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The Pittsburgh & Lake Erie Cantilever Bridge Over the Ohio River at Beaver, Pa.

(With two-page inset sheet.)

One of the most noteworthy steel bridges of recent years was completed during 1910 and has now been in service some nine months. This is the new double-track through-truss bridge of the Pittsburgh & Lake Erie R. R. crossing the Ohio River between Monaca and Beaver, Pa., 25 miles north of Pittsburg. It is of the three-span cantilever type, with 769-ft. central span and 320-ft. anchor spans, flanked on the north by a simple trus approach span 370 ft. c. to c. end pins. In method of connection it belongs to the modified pin-connected class so deservedly popular at present; the tension chord and most of the tension diagonals are eyebars, connected by pins, while all rigid members (with a few exceptions), all floor hangers and all members subject to reversal of stress are connected by riveted joints.

The Beaver bridge is a very heavy structure. Although double-track as to width, yet it actually carries four tracks, gauntleted in pairs with 1 ft. separation, the railway having four tracks on both sides of the crossing. This and the design to make the floor safe even under derailed equipment led to the use of additional stringers and thus increased the floor weight. Further, the bridge was designed for rather heavy railway loading, and the style of detailing is ample, all of which tends toward a heavy structure.

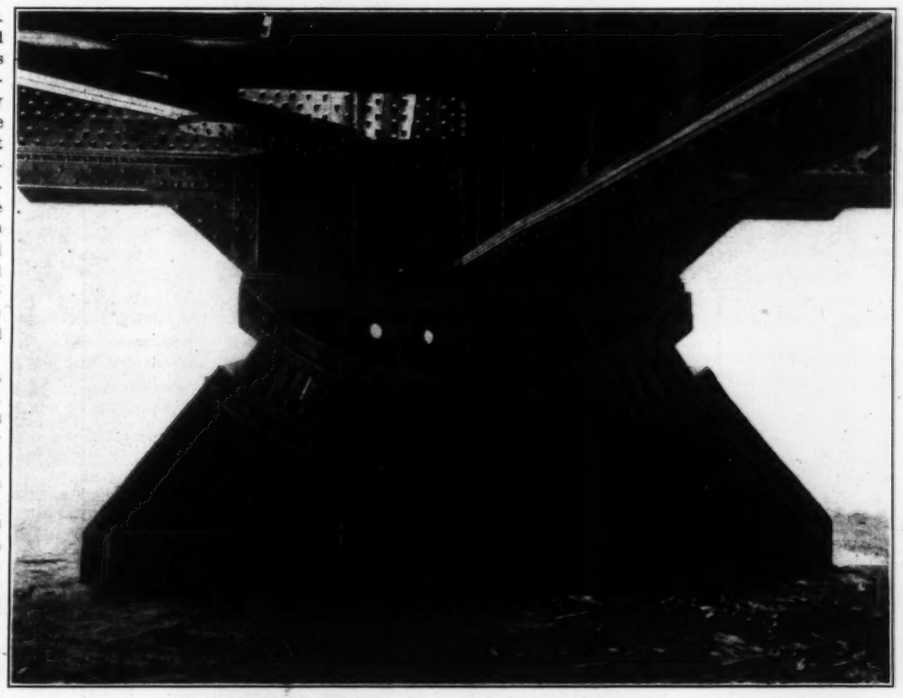


FIG. 1. ROLLER-JOURNAL BEARING ON MAIN PIER OF NEW CANTILEVER BRIDGE OVER THE OHIO RIVER AT BEAVER, PA.

(The load on this bearing is about 6,000 tons. The 29 segmental rollers are 11¾ ins. in diameter by 6½ ft. long, set on a circle of 9 ft. radius. Gear teeth bolted to their ends meshing with gear segments on the shoes hold them in alinement. The shoes are steel castings; the lower one is about 18 ft. long by 8½ ft. wide and weighs 37 tons. The small triangular webs which may be seen in all hollow angles of these castings were used instead of full fillets.)

While this structure is more than ordinarily interesting in all phases of its history, it is particularly notable because of certain elements of design and construction which represent distinct advance in steel bridge practice. The chief ones are:

1. A roller-ring bearing, constituting a frictionless hinge, on the main supports on the channel piers (Fig. 1) to eliminate distortion-bending at this heavy panel-point.

2. Full-section or 100% splices in all built members, including the heavy compression chords, and excepting only the tower posts.

3. A central diaphragm in the compression chords, in conjunction with substantial latticing on both flanges, making three lines of cross connection; and efficient transverse diaphragms.

4. A wedge bearing at the anchorage which keeps the anchor bars under constant tension and makes due provision for expansion of the bridge (Fig. 5); and in connection therewith a separate wind abutment.

5. Expansion bearings of stringers in alternate bays to free the stringers from sharing in the chord stresses.

6. "Skid girders" along the truss at mid-height of car to protect in case of derailment.

7. Tapered rivets instead of the ordinary cylindrical rivets, wherever the grip length was great enough to make tight driving difficult.

8. Pin bushings at those pins where expansion motions of the structure are concentrated.

9. Assembly of main members in the bridge-shop yard in position of dead-load deflection.

These and other characteristics are described more fully in the present article and in a subsequent one dealing with construction and erection of the bridge. The substructure has already been described, in our issue of May 5, 1910.

History of Bridge.

A single-track bridge built in 1878 served as Ohio River crossing of the Pittsburgh & Lake Erie R. R. for only 12 years. It comprised two through and three deck spans and approach viaduct. By 1890 the increased weight of trains demanded a stronger bridge, and a new single-track superstructure was therefore built on the old piers. This was operated at first single-track, and later with two tracks in gauntlet arrangement, the railway having been changed to double-track. Within the last decade this bridge also has been outgrown by weight of trains. Locomotive weights were increased in 1897, in 1902 and subsequently, to raise the train tonnage of the road from 1,600 to 2,500, to 3,500 and finally to 4,200 tons. But the increase of traffic was greater than the train-tonnage increase, and the number of trains grew so rapidly that five years ago it became necessary to plan for four-tracking. A new bridge at Beaver was an essential part of these plans.

The old bridge having narrow piers, and their enlargement for a double-track superstructure being hardly practicable (they rested on timber grillage on gravel), a wholly new bridge had to be constructed, for which a new location was selected about 300 ft. upstream of the old. River interests insisted on a wider channel than the old bridge afforded, and it was due to their demands that the pier locations and therefore the spans of the new structure were fixed as they now are.

An unobstructed channel width of 700 ft., was provided, to agree with the 700-ft. channel width fixed by the government bear-trap dams above and below. The clearance above low water was

made 90 ft. as required by the government in this section of the Ohio River. The resulting general dimensions are shown in Fig. 3.

Starting at this point, the outline of the proposed bridge was determined by the Chief Engineer of the railway. The prohibition of the use of falsework, and the span length, practically fixed the cantilever as the type of the structure. Mr. Albert Lucius, of New York City, as Consulting Engineer for the railroad company, designed and drew up the general plans.* On these as a basis the details were developed by the contractor, the McClintic-Marshall Construction Co., of Pittsburg. Mr. Paul L. Wolfel, Chief Engineer of this company, assumed personal charge of the task.

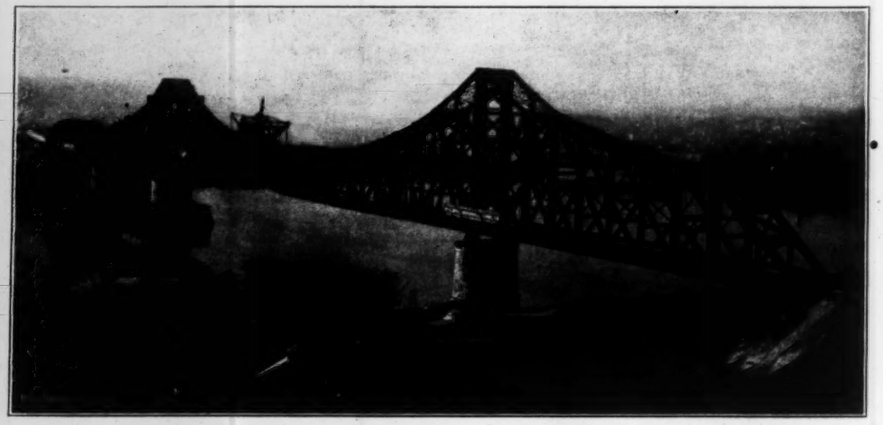


FIG. 2. VIEW OF THE BEAVER BRIDGE WHEN NEARLY COMPLETED (MARCH, 1910).
(Looking northerly from Monaca approach to old bridge, toward Beaver.)

The data and specified values governing the design of the bridge, and the floor construction, may be summarized briefly as follows:

DIMENSIONS AND CLEARANCES.—Spans and heights as given by Fig. 3. Spacing of inner (freight) tracks, 13 ft. c. to c.; gauntlet spread, 1 ft.; hence spacing of outer (passenger) tracks, 15 ft. c. to c. Clearance from center of outer track to face of skid girders, 7 ft.; to face of truss, 7½ ft., although the floorbeam bracket encroaches on this width. Hence, width in the clear between trusses, 30 ft. Width c. to c. of trusses, 54½ ft. Vertical clearance from top of rail to bottom face of overhead bracing, 21½ ft. Limiting floor depth, 6 ft. from underclearance to top of rail; this was fixed at the practical minimum, to reduce the unnecessary lift of rail-way traffic (see Fig. 4). The railway has a maximum approach gradient of 0.3% for about 2 miles. The grade over the bridge is practically level.

LOADING.—For floor, Cooper's E60, equivalent to 6,000 lbs. per lin. ft. of track preceded by two locomotives each of 426,000 lbs. For trusses, E60 less 60%. Each pair of gauntleted tracks was assumed to carry a train, of any length needed to give maximum stress, or two separated trains where split loading produced maximum stress. Wind, 300 lbs. per lin. ft. on trains, 30 lbs. per sq. ft. on trusses and floor; of the latter amount 20 lbs. was taken as moving load. The lateral surface of two trusses and the floor was counted in computing the wind pressure.

The dead-load, after a first assumption, was determined from the stress-sheets, and the stresses were then revised. From the new stress-sheets general detail drawings were made, and dead-load concentrations recomputed from the actual details. Further revision of dead-loads and adjustment of sections to suit were carried up to a point where the actual sections did not differ more than 2% from the sections required by the stresses.

RAILWAY DECK.—Designed to give a large degree of safety in cases of derailment, which result is aided by the location of the stringers. Ties are 12½ ft. long, of white oak 7 × 9 ins. sized to 8½ ins. and placed on edge; they butt over the middle stringer and thus cover the whole width of floor between floorbeam brackets. Ties are spaced 3 ins. apart in the clear, by three lines of pine spacing blocks on each half of the floor width. The top face of ties is 1½ ins. above the floorbeams; metal plate spacers keep the nearest tie ¼-in. away from the floorbeam to let cinders blow off the flange surface. All wood was treated by open-tank immersion in Carbolineum Avenarius at 200° F.

Rails, 100-lb. section, 33-ft. lengths. The four track-rails of each gauntlet are protected by one pair of inside guard-rails of the same section, making 12 lines of rail on the bridge. They were laid with such width of joint as to give ⅜-in. expansion space at lowest temperature (−20° F.), and no special slip-joints are provided for the expansion. Over the main piers and on the approaches the rail is fixed by special anti-creeping devices. As the bridge expansion is concentrated at the ends of anchor and cantilever arms, it is independent of the rail movement and requires the rail to slip. The rail rests on tie-plates of special type, described elsewhere in this issue.

SPECIFIED UNIT-STRESSES.—Members subjected to stress of one direction only were proportioned for the sum of dead-load and live-load stresses plus an impact allowance

$$i = l \frac{l}{d + l}$$

except that for hangers the impact allowance was made 100% of the live-load stress. In members subject to stress reversal, four-fifths of the smaller stress was added to both stresses and the member proportioned to carry either resulting stress. This being understood, the following unit-stresses governed:

DIRECT STRESS AND GIRDER BENDING.

Vertical loads, tension		16,000 lbs./in.²
	compression,* max.	14,000
Wind, tension		20,000
	compression,* max.	18,000
Vert. loads plus wind, tension		22,000
	compression,* max.	20,000
Erection stresses, tension		18,000
	compression,* max.	16,000

RIVETS, PINS, ROLLERS.

Shear	11,000 lbs./in.²
Bearing, rivets	22,000
Bending in pins	24,000
Field-rivet excess	25% for hand-driven
Field-rivet excess	10% for pneumatic hammer rivets
Roller pressure, 12-in. segmental rollers, per lineal inch	6,000 lbs.

*These are the maximum amounts only. Struts were proportioned by a reduction formula starting from the tensile unit-stress as base; for vertical loads the formula is

$$\frac{16{,}000}{1 + \frac{l^2}{12{,}000\, r^2}}$$

this formula being cut off at 14,000 lbs. as noted.

The shoes were designed for a masonry pressure of 400 lbs. per sq. in. = 29 tons per sq. ft.

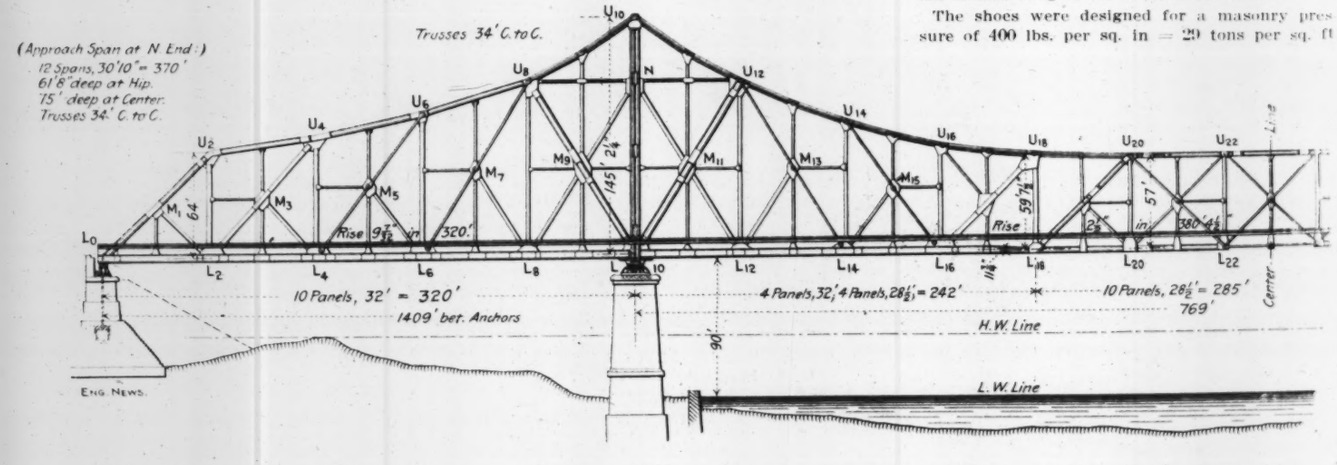


FIG. 3. OUTLINE SKETCH OF NEW BRIDGE OVER THE OHIO RIVER BETWEEN MONACA AND BEAVER, PA., PITTSBURGH & LAKE ERIE R. R.

*The extent of this work may be judged from the fact that these plans included 28 sheets.

Materials.

STRUCTURAL STEEL.—All rolled structural steel was required to be basic open-hearth steel with sulphur and phosphorus limited to 0.04%. The material of built members was to meet the following requirements in specimen tests:

Ultimate strength	56,000 to 64,000 lbs./in.²
Rivet steel	48,000 to 56,000)
Elastic limit	33,000 lbs./in.²
Elongation	20%
Rivet steel	28%)
Reduction of area	50%
Rivet steel	55%)

Pin steel, for pins and rollers, was specified 62,000 to 70,000 ultimate, 36,000 elastic limit, 22% elongation, 45% reduction of area.

The segmental 12-in. rollers of the main shoe bearing were tested to determine their safe carrying capacity by cutting a section 1 in. thick from one end of a roller and loading it in a compression machine. In three tests, no set could be detected at 15,000 lbs., but a slight set was observed at 25,000 lbs. These rollers in the bridge carry less than 6,000 lbs. per lin. in. at the maximum.

EYEBARS.—Only full-size test figures were specified, leaving it to the bridge company to order the plain bars of such grade as to meet

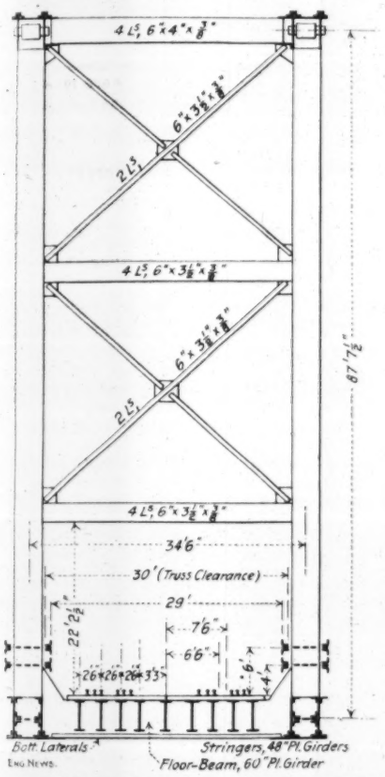


Fig. 4. Outline Cross-Section of Beaver Bridge, Showing Stringer Arrangement and Skid Girders.

the full-size requirements. The eyebars were to break in the body and develop:

Ultimate strength	56,000 to 66,000 lbs./in.²
Elastic limit	33,000 to 38,300
Elongation, in 10 ft.	12%

The results obtained during the eyebar tests, and their comparison with the specimen tests, will be discussed separately in a future issue. Generally it may be said that highly satisfactory eyebars were obtained.

The compressive yield-point of 1-in. cylinders 1-in. high was found to be 27,000 to 29,000 lbs. per sq. in., compared with an average tensile yield-point of 35,100.

STEEL CASTINGS.—Several important parts being cast of steel (main shoes, anchorage shoes, tower post caps), the determination of quality of steel castings was important. The requirements were an ultimate strength of 65,000 to 70,000, elastic limit at least half the ultimate, elongation 20% (in 2 ins.), reduction of area 45%, and 90° bending on a radius equal to thickness of sample. Most of the tests actually showed an elongation of 25% or better. A satisfactory appearance of fracture was also looked for, as evidence of thorough annealing, and in some cases annealing was required when the fracture was coarse. The steel contained about 0.27% C, 0.5% Mn, and 0.27% Si.

Compression tests of cubes from steel castings showed low elastic limit. The first permanent set was observed at 13,000 lbs. per sq. in.; at 100,000 lbs. the compression was 16%; at 200,000 lbs. the 1-in. squares had increased to 1¼-in. squares, and at 250,000 lbs. to 1 7/16-in., without cracking.

MANGANESE BRONZE.—Pin bushings, and guide-plates of wind connections at suspended span and at anchor arm, are of manganese bronze, selected by test as being the most ductile high-strength anti-friction composition. Preliminary tests resulted in the following specification:

Tension test:	
Ultimate strength	75,000 lbs./in.²
Elastic limit	35,000 lbs./in.²
Elongation (in 2 ins.)	25%
Reduction of area	25%
Compression test:	
Elastic limit	28,000 lbs./in.²
Permanent set at 100,000 lbs. (on 1-in. cube)	0.10-in.
Bending test:	
Cold bend through arc of 120° on radius equal to thickness.	

No difficulty was found in obtaining such material; in fact the tests averaged 80,000 lbs. ultimate in tension, while a bend of 180° was usually obtained.

Design.

The general plan including all typical details having been worked out by the consulting engineer, bids were asked with provision for alternative designs. No alternative designs were received, but some criticism was had of the provision of a fixed (flat) base for the tower post. In consequence a design was drawn up for a cylindrical roller bearing, which was built (see Fig. 1).

The detail plans were developed by the contractor, who was required to guarantee by a very heavy bond the safety and sufficiency of the structure until its official acceptance by the railway. The determination of channel span has been mentioned. The anchor spans were selected of what was considered to be a suitable proportionate length. The location of channel as dictated by the river interests forced one anchor span wholly over land, and made an approach span necessary at the other (Beaver) end.

Panel lengths were determined from the limitations on floor depth (6 ft.) already mentioned. A panel of approximately 30 ft. was chosen, and the following arrangement resulted:

Anchor arm	10 panels of 32 ft.	320 ft.
Cantilever arm	4 panels of 32 ft.	
	4 panels of 28½ ft.	242 ft.
Suspended span	10 panels of 28½ ft.	285 ft.
Approach span	12 panels of 30 ft. 10 ins.	370 ft.

The width between trusses being 30 ft. in the clear, the panels are practically square.

FLOOR.—The stringer arrangement was necessarily adapted to the gauntlet track arrangement. As shown by cross-section in Fig. 4, there is one stringer for each running rail (though not directly under the rail), and a middle stringer as safety provision. The bottom laterals of the truss system are double 6 × 4-in. angles in the bottom plane of the floorbeams, and are hitched to five of the nine stringers; a secondary system of single 3½ × 3½-in. angles connects the other stringers into the lateral system. Further, the stringers are stiffened by three lines of sway-frames in each panel, one of these being placed close to the expansion end of the stringers.

The stringers are 48-in. plate-girders; the middle one is lighter than the others, impact being not counted. In order to keep chord stresses out of the floor, one end of stringers in alternate bays is supported on a shelf of a sliding support. At the ends of the cantilever arms, where expansion is concentrated, pocket bearings replace the simple brackets, to permit of greater range of expansion movement of the stringers. By this ample expansion provision, the stringers are divorced from any share in transmission of the bottom chord stress. At the anchorage, the gap between end floorbeam and face of abutment is bridged by a set of 12-in. I-beam stringers. These slide on the shoe-plates on the abutment.

The floorbeams, 60-in. plate-girders, are increased in depth at the ends by deep knee-brackets on their upper side, making the end face 9 ft. high. They are riveted directly to the inner faces of the posts or hangers. The trusses being detailed with all pins outside of the bottom chord (except in the suspended span), the floorbeams did not require notching and thus have very rigid connection to the trusses. The suspended span has a much shallower bottom chord, which made the notching of the floorbeams to clear the pins less serious.

The truss system shows the ordinary subdivided-panel form with the addition of mid-length auxiliary stay-members for top chords and posts, a feature generally found in large bridges and useful mainly as a convenience in erection. The only departure from simplicity occurs in the panels adjoining the tower post, where the horizontal member U8-U12 and the auxiliary diagonals extending from M9 and M11 up to the tower post were introduced. These were found to be of service in erection. The horizontal member U8-U12 must unavoidably share in the top-chord tension.

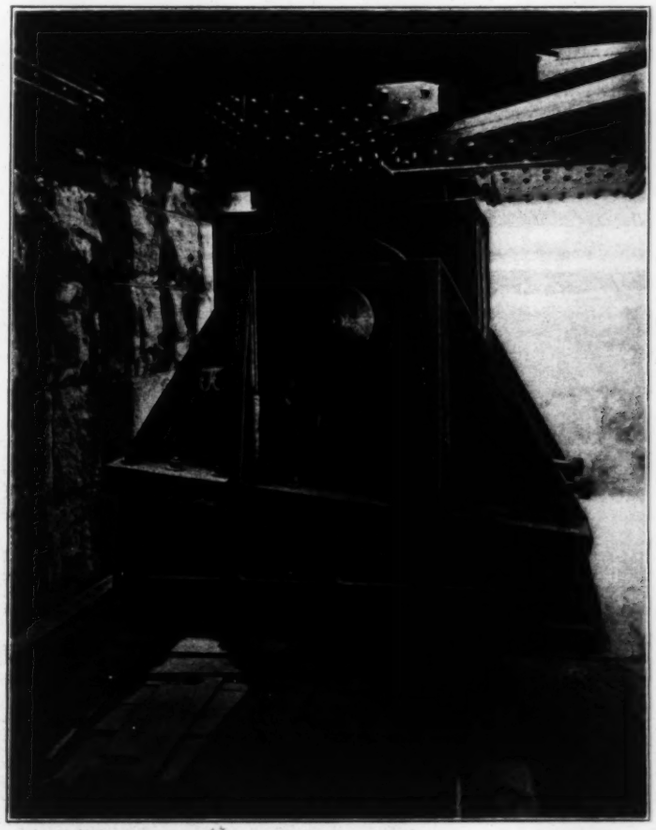


FIG. 5. ONE OF THE ANCHORAGE BEARINGS OF THE BEAVER BRIDGE.

(With crosshead block at upper end of anchorage eyebars, wedge adjustment under block to hold eyebars in maximum tension, and rocker connection from block to end pin of bridge. The bearing takes no wind reaction, this being carried to a special wind abutment at middle of end floor beam.)

Its section therefore was proportioned on general considerations, the total stress carried through it was then determined by multiplying by the top-chord unit-stress, and end connections capable of transferring this total stress were provided.

TYPE OF TRUSS DETAILS.—As a basis for the detailing of members and connections the rule was adopted to make riveted connections

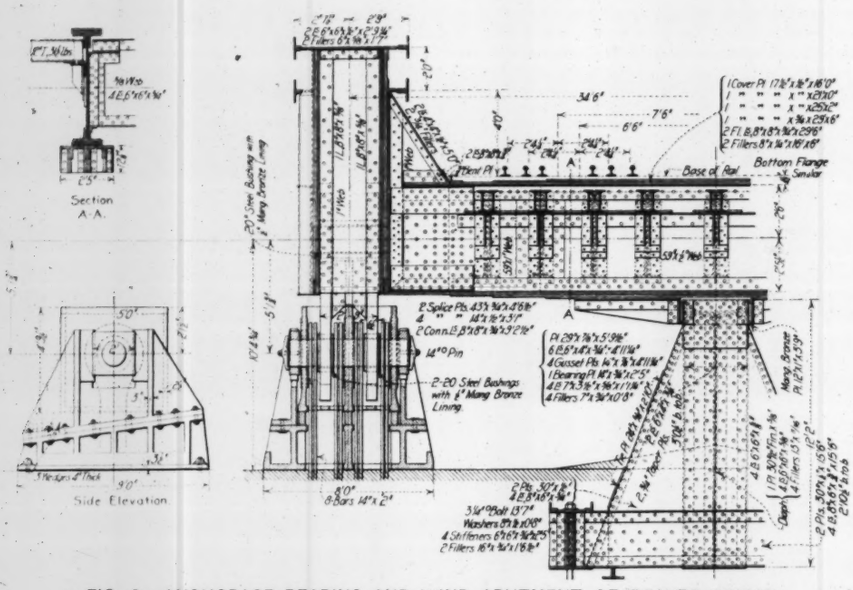


FIG. 6. ANCHORAGE BEARING AND WIND ABUTMENT OF BEAVER BRIDGE.

(Longitudinal expansion movement of the bridge is allowed for in the anchorage bearing by means of the rocker connecting the pin LO to the crosshead block, and at the wind abutment by a sliding joint lined with manganese bronze bearing-plates.)

for all post and hanger connections to the bottom chord, all main connections where stress reversal takes place, and all minor connections; and to make pin connections generally for main diagonals free from stress reversal, whether of eyebars or of built construction. Stress reversal occurs in a large part of the anchor arm, which is relatively long and has very small dead-load uplift; the top chords to point U6, the bottom chords to point L4, and the webs to and including member L2-U4 have to carry reversed stresses. The top chord, however, was designed as a built-up rigid member to U8, which resulted in making the anchor arm self-supporting as a simple span before cantilever work was begun, and thus safeguarded against accident from washing out of the falsework.

The tension member U6-U8, unlike the other stiff sections of the top chord, has pin connections, and therefore (to reduce pin moments) was made up with four webs, whereas all other compression members of the bridge have only two webs.

The pins connecting the diagonals to the bottom chord were placed outside of the chord, in extensions of the large connection plates of the posts. Though this was done primarily to keep the floorbeams free from notching, it secured also more substantial construction of the ends of the diagonal members.

Compression Members.

The characteristics of the compression chords and other struts are of primary interest. A maximum section of 466½ sq. in. was required in the bottom chord, and the tower post required 640 sq. ins. With such large assemblages of metal the difficulties of design are extreme, and a robust member is not easily secured without leading the shopwork and erection into great complications. In the Beaver bridge these members are of excellent shape and proportions.

Two webs or ribs laced together form the foundation of the compression member sections. Several vital features modify this grouping:

1. A central longitudinal diaphragm of substantial proportions, part or all of whose sectional area adds to the main compression section, is used in the heavy members (chords and tower post). In the chords this diaphragm is a strong lattice girder, having 8 × 8 × ⅞-in. flange angles and a double web system of 7 × 3½ × 7/16-in. angles. In the tower post it is a thick plate-girder, with 8 × 8 × ¾-in. flange angles and 1¾-in. web thickness (two ⅞-in. plates).

2. Solid transverse diaphragms at intervals of 5 to 6 ft. Except those at the panel-points, they are in two independent halves, separated by the central diaphragm; at the panel-points, however, the two halves are fitted around the flange angles of the central diaphragm so as to seat on the end batten of this diaphragm and are riveted together through the batten, so that the transverse diaphragm becomes a solid unit and helps to distribute the floorbeam load over both ribs.

The transverse diaphragms prevent all distortion of the cross-section of the members. In addition they served during the shop assemblage of the member to ensure straight and parallel assemblage. With this special object in view the transverse diaphragms were planed to exact width, and in assembly the diaphragms were set up in position and the webs of the member then brought against the planed faces and riv to them before the flange lacing was pu In consequence no trouble from tendency to in assemblage was encountered.

3. The flange lacing was designed in va ways to promote solidarity of the member great transverse strength. The lacing (som it bar lacing, some single-angle lacing) is he than usual, and the full strength of the ba developed by the end attachment, gussets b used where necessary to give room for a ficient number of rivets. For greater immu from injury to the lacing in handling the m bers, and to give flat surfaces to the memb the lacing was attached to the inside of flange angles. With this construction the ing bar could engage only the inner angle, wh as the forces transmitted by the lacing sho be distributed to all parts of the flange; in or to secure such effect, tie-plates were riveted the outside of the pair of flange angles o the lacing attachment points.

The end diaphragms were modified in a numb of compression members to facilitate entering i erection. In these cases the diaphragm was spli longitudinally and spliced with plates. The halves being riveted to the sides of the mem during assembly, the splice holes were ream in the yard when the member had been assemb to the truss. In shipment the splice was mer bolted, and thus the end of the member h enough "give" to enter easily between the cho in erection. When the splice was riveted in th reamed holes it drew the sides of the mem tight to the chord.

SPLICES.—The unusual decision to develop th full strength of the main section in the splice of all compression members, without relian on butted joints, called for very careful stud in designing the splices. The object sought w accomplished by distributing the splice over suc a length of member (with the several web-plate cut at different points) that the stress-transfe of different web-plates occurred at different point of the length.

Typical anchor-arm bottom-chord splices ar shown in the drawings on our inset-sheet. A the point L8 the ribs of the chord have each three web-plates. The two outer plates ar cut at the center-line of the splice, but the mi dle plate is cut 22¼ ins. to one side and for con venience in shop and field is also cut at the corre sponding point on the other side, giving a loos insert plate. The outside splice-plates lap past the joint of the central plate enough to take up its stress before its splicing-point, and transfe the stress to the insert plate before the splicing-point of the outer web-plate is reached. Th middle part of the splice-plate then has only to splice the outer webs. The flange-angles and

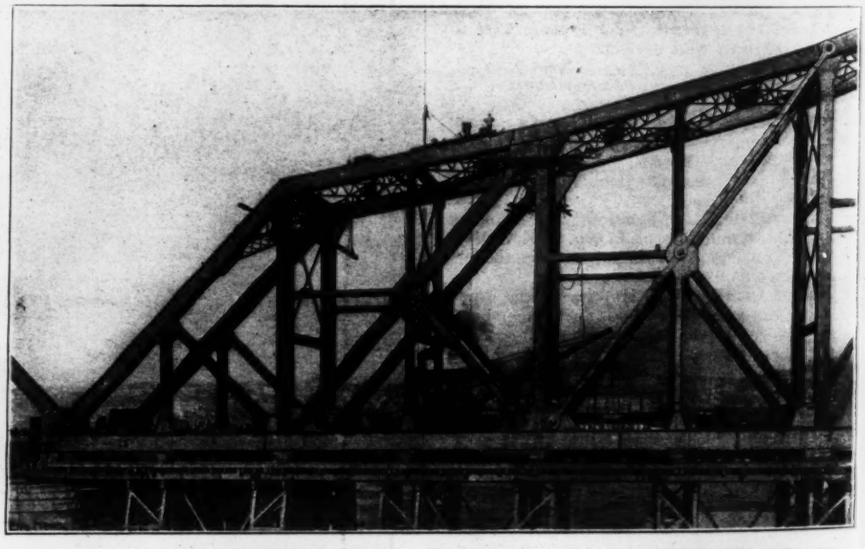


FIG. 7. VIEW OF NORTH ANCHOR ARM (BEAVER END) OF BEAVER CANTILEVER BRIDGE.

(Illustrating the general style of connections used in the bridge.)

central-diaphragm angles are also spliced at the center-line of the joint, the former in part by tie-plates and in part by auxiliary attachment angles of the large connection gussets.

The width of the lower chord (3 ft. 6½ ins. back to back of outer flange angles in all sections) made it desirable to stiffen the edges of the tie-plates and diaphragms. Such stiffening was provided by riveting angles along the underside of the transverse edges, as may be seen in the sketches on our inset-sheet and also in Fig. 8. The same device is used on tie-plates of other members, particularly those of the tower post.

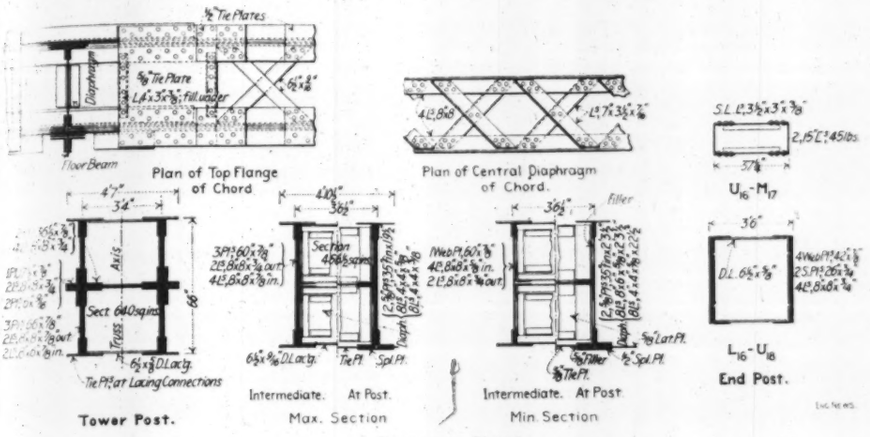


FIG. 8. TYPICAL CROSS-SECTIONS OF COMPRESSION MEMBERS. BEAVER BRIDGE.

Special effort was made, in detailing all splices, to secure symmetrical grouping of the splice material. In most cases this object was attained almost perfectly. Besides avoiding various secondary stresses of uncertain amount, it utilizes most of the splice rivets in double shear.

The difficulties arising during erection at the splices of the chords are largely absent in the case of the tower post, since this member, being vertical, has its joints forced into bearing as the sections are set in place, and undergoes practically no subsequent distortion by action of the progressive erection of the cantilever work. Therefore it was thought sufficient to provide splices equal to half the capacity of the body of the post, relying on the faced joints for carrying their share of the load. The arrangement of the splices is considerably simpler than in the case of the chords, because of the lower ratio of splice-section.

The splices in question so far are the field splices, most members having all their parts unbroken from end to end of the shop-assembled sections. In a few cases shop splices were made for special reasons, and these are arranged quite like the field splices.

It will be seen from the drawings of bottom chord panel-points that the chord flange-angle facing the roadway, in the upper flange, is cut away at the floorbeam seat. The floorbeam, with its bracket attached, could therefore be lowered to place between the posts during erection, without interference. The loss of section of the chord is made up by the extra section of the gusset-plate.

SPECIAL PARTS.—Certain parts of the bridge are individually notable. Among them are: 1. The main bearing under the tower post; 2. the anchorage bearing; 3. the junctions and bearings of the wind system; 4. the cap of the tower post; and 5. the rocker on which hangs the end of the suspended span. The two first-mentioned parts exhibit special invention and represent important innovations in cantilever bridge construction.

Main Bearing.

The reason for the adoption of the roller bearing as designed by Mr. A. Lucius and shown by Fig. 1 and our inset-sheet is concisely stated by Mr. P. L. Wolfel as follows:

"At this point a total reaction of 12,558,000 lbs. for dead-load, live-load and impact has to be taken care of. The bearing was originally designed as a fixed bearing, and calculations showed that this fixed bearing produced secondary stresses* in the chord L9—L10 ranging from ± 18,000 to ∓ 19,000 lbs. per sq. in., and in the chord L10—L11 ranging from ± 5,000 to ∓ 25,000 lbs. per sq. in., at the same time increasing the masonry pressure from 400 to nearly 1,000 lbs. per sq. in. It was then decided to make the bearing movable.

As little reliance can be placed on members turning on pins under heavy pressure, a segmental roller bearing has been used. This reduces the secondary stresses (even making the maximum allowance for roller friction) to less than 3,000 lbs. per sq. in.

In the masonry were built 18 24-in. 120-lb. I-beams, which were supported before concreting on four 6 × 6 × ¾-in. planed angles, set exactly level. These beams support the main casting, which is about 18 ft. long and 8½ ft. wide and weighs 37 tons. The bridge is supported on an upper casting, and between the two are 29 segmental rollers 4 ins. wide, 11¾ ins. high and 6 ft. 6 ins. long, set radial to panel-point L10 on a circle of 9 ft. radius. The upper casting is turned to a radius of 8 ft. 6⅛ ins. and the lower casting to a radius of 9 ft. 5⅞ ins. The rollers are held in place by means of gear teeth at each end of each roller which engage suitable racks bolted to the upper and lower castings.

It was noticed by measurement and marks established on the castings that during erection, when the cantilever was built out more and more and the U10 point moved forward, the roller nest perfectly followed the motion.

It may be added that motion of the rollers is observable also under live-load.

It was intended at first to encase the bearing with a weather-tight hood filled with oil or grease, to ensure permanent working condition. This idea was not carried out, however; the spaces between rollers were packed with grease-soaked waste, and no further protection was attempted.

Anchorage Bearing.

The reaction at the anchorage varies from positive to negative depending on the position of live-loads. Under dead-load alone there is a very small uplift, 33,000 lbs., so that the live-load effect predominates, and the result is that each anchorage shoe may have a downward pressure of 2,071,000 lbs., or an uplift of 2,299,000 lbs. The anchorage eyebars take care of the tension when existing, while downward pressure must be carried to the masonry by a shoe. This alternation of anchorage reaction constitutes a possible "hammering" effect which it was desired to avoid. Due to the stretch of the 60-ft. anchorage eyebars under uplift, and release of this stretch when the uplift disappears, the vertical motion of their upper points would be approximately ⅜-in., quite enough to give rise to objectionable hammering. The anchorage bearing as designed and built solves the difficulty very successfully.

The result is accomplished by a wedge under the pin at the top of the anchor eyebars, which wedge bears on the shoe seated on the abutment pier and thus, if driven home at a time when the eyebars are at maximum stretch, prevents them from shortening when the uplift decreases. Thus the variations of the reaction are absorbed by the mass of masonry of the abutment, and the eyebars are held in a constant condition of stretch except for the slight influence of whatever resilient motion may be developed by the masonry under its varying loading. But the cross-action of the pier is so large as to make it practically incompressible as regards this action.

*From live-load and wind only. The dead-load stress is central in all members, the shop and field work being conducted so as to shape all members to the truss outline under full dead-load, and to connect them in the field for this position. Insofar as these efforts were successful, the truss is free from distortion when fully erected and before live-load is applied, which means that dead-load stresses are central. Under live-load or wind, the structure is distorted, and bending at the joints occurs, giving rise to secondary stresses.

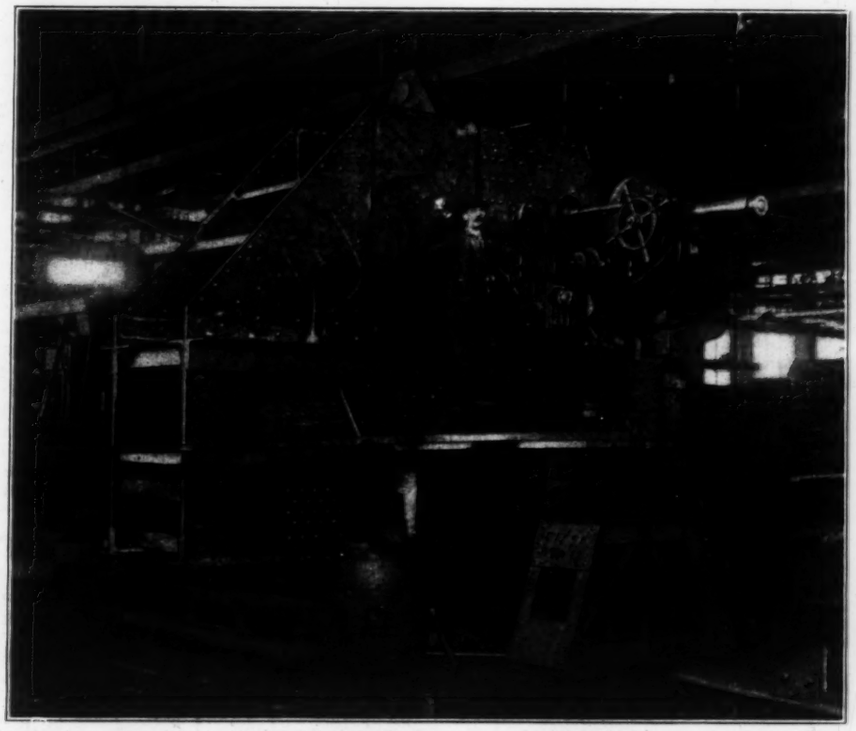
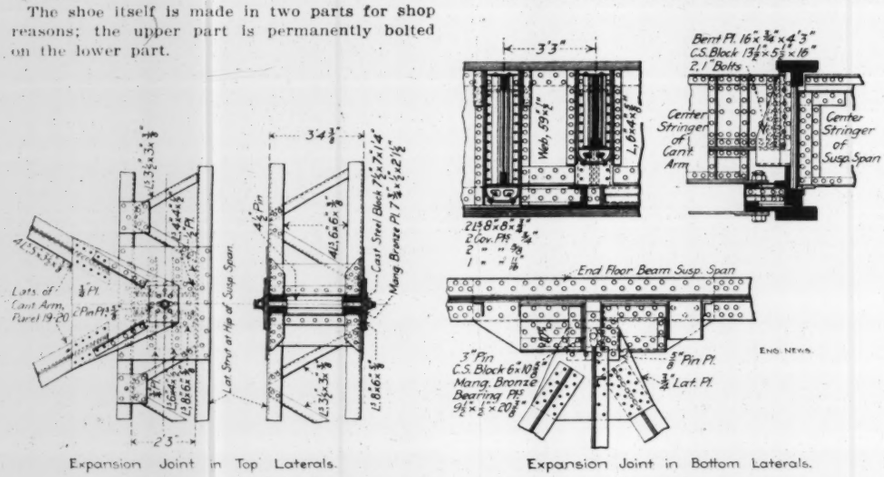


FIG. 9. HEAVY SHOPWORK ON BEAVER BRIDGE MATERIAL.

(Bottom chord panel point of cantilever arm, L14, in the shop of the McClintic-Marshall Construction Co.; Boring the pin-hole for attaching eyebar diagonal.)

Referring to Fig. 6, showing the anchorage bearing, it will be seen that the shoe is hollow and affords room within it for a cast-steel block engaging the anchor eyebars by a pin. Under this block are cast-steel wedges, bearing on inclined seats formed on the shoe. The end pin of the bridge is connected to the block by a built-up rocker, 5 ft. 1¾ ins. long c. to c. This rocker allows the expansion motions of the bridge trusses to go on independent of the anchorage. At the same time the slight obliquity of the rocker at extreme positions of the trusses (the motion of the end pin of the truss may be 2½ ins. either way from the mean due to temperature, and ⅞-in. due to live-load stress) produces a side pull or thrust at the shoe, of 100,000 lbs. at the maximum. By shaping the ends of the eyebar block as a slide, fitted into guide jaws formed by the outer webs of the shoe, such forces are absorbed by the shoe and are prevented from putting a bending stress on the eyebars.

The shoe itself is made in two parts for shop reasons; the upper part is permanently bolted on the lower part.



Expansion Joint in Top Laterals. Expansion Joint in Bottom Laterals.

FIG. 10. WIND-TRANSFER DETAILS AT END OF SUSPENDED SPAN.

To drive the wedge into full bearing it is backed by a set of screws, working in lugs of the shoe. When once adjusted they do not require to be used again. The adjustment of the bearing (after completion of the bridge) will be mentioned later, in speaking of the erection.

Both pins of the rocker are bushed, in view of their being designed to be moving joints. Steel bushings are set in the built member, and these are lined with manganese bronze lining forced into the bushing. The length of bearing is considerably greater than would be feasible with direct seating of the pin in the ordinary way.

WIND TRANSFER.—The lateral system or wind truss of the bridge has special details at the ends of the suspended span, where the lateral stress must be transferred without preventing free longitudinal motion of suspended span relative to cantilever arm, and at the anchorage.

Lateral supports or end abutments of the wind system on the anchor piers were most conveniently kept separate from the anchorage bearings. Therefore a wind abutment, Fig. 6, was provided at the middle of the end floorbeam. It is a pedestal partly embedded in the masonry and projecting up in the shape of a rigid post to the under face of the floorbeam, where the bridge engages it. Here the longitudinal expansion movements of the bridge had to be allowed for, and to this end the connection is detailed as a slide-block bearing. The contact faces are manganese bronze against steel, ground to a fit.

The transfer of wind reaction at the ends of the suspended span is accomplished at two longitudinally sliding connections, one each in upper and lower laterals (Fig. 10). The upper lateral system of the suspended span ends at the hip of this span, and the joint is located here, on the middle of the width. It comprises a slide-block terminating the lateral system of the cantilever arm, engaging a pair of guide jaws at the middle of the hip strut of the suspended span. The jaws are lined with manganese bronze.

In order to extend the upper laterals of the cantilever arm across the open space U 18 — U 20, where the main trusses are interrupted, the eyebars used here as erection ties are utilized for wind-truss chords. Since they carry no main-truss tension after the bridge is connected at the center, they are subject to compression as well as tension from the wind truss. These eyebars are made able to take the moderate compression thus arising, by lacing together, the lacing being attached to longitudinal angles riveted along the faces of the eyebars.

ROCKER HANGER.—The suspended span is hung from panel-point U 18 of the cantilever arm by a rocker, which on account of expansion movements of the bridge may at different times incline 2 ins. either side of the vertical. The pin connections of the rocker are therefore bushed with steel lined with manganese bronze, like those of the anchorage rocker. While this reduces the bearing friction, it still leaves enough friction to give rise to considerable bending in the hanger. On this account eyebars were not thought satisfactory, and the hanger was detailed as a built member. At both upper and lower panel-points it was inconvenient to seat the rocker on the panel-point pins; separate pins were provided, in suitable connection plates riveted to the inclined end posts for the purpose (see drawing on inset-sheet).

TOWER-POST CAP.—The cap section of the tower post is a steel casting, which affords a much simpler means of transferring the large vertical component of the top-chord stress than a riveted cap. It was possible to make the eyebar connection by a single pin, although each chord consists of 16 eyebars 16 × 1⅞ ins; therefore the casting does not have to transmit the chord tension. The pin is 16 ins. in diameter by a grip length of 8 ft. 2½ ins. The vertical component is taken by five ribs of the casting which extend up and support the pin. These are continued up above the eyebars to give attachment for the upper hitch-plate of the lateral system; the lower hitch-plate is fastened to a shelf cast on the inner face of the cap. This cap casting, a single piece, has extreme dimensions of 8 ft. long, 7½ ft. wide and 8½ ft. high; it weighs 34 tons.

Other Details.

The splices of the bottom chord were made directly adjacent to the panel-points, and each section extended across one main panel (two floor panels). The connection plates engaging the posts and diagonals were built as part of the chord, being arranged to replace one or more of the web-plates. Thus the bottom chord was built in sections extending from just beyond one main (even-numbered) panel-point to just beyond the next main panel-point, the section including all parts of the farther panel-point. Such sections, as used in the anchor arm, weighed up to 86 tons.

Because of heavy diagonal connections in cantilever arm, even greater weights would have been reached here had this arrangement been followed. But it was desired to secure light parts for handling in the erection of the cantilever work, and the panel-points of the cantilever arm were therefore made separate from the bottom-chord sections, i. e., the chord is field-spliced on both sides of the panel-point. By this means the heaviest single piece handled in the cantilever erection was reduced to 50 tons. The panel-points L14 and L16 of the cantilever arm are quite heavy because the posts L14-U14 in the former and the diagonal end post L16-U18 in the latter were field-spliced just outside of the panel-point and the stub ends were shop-riveted to the panel-point. This avoided carrying strains during erection on bolts, the butt joint transmitting to the shop-riveted connection at the panel-point.

An exception to the general plan of utilizing the panel-point connection plates as part of the main section of members occurs at the crossing of lower chord and tower post. Here most of the stress in both members continues past the intersection, and as the stresses and cross-sections are also very heavy, the material of the two members was separately carried through the panel-point. The bottom chord is field-spliced immediately adjacent to the tower in both anchor and cantilever arms; its connection plates extend through and carry its section through the post, but they also extend up to receive the pins of the diagonals. Here as in many other cases the connection plates were doubled and their corners or edges reinforced, to resist tearing actions on the plate from all possible stress variations.

The riveted intersections of the web system are remarkable chiefly for their size. It will be noted from the few examples shown on our inset-sheet that special care was taken to stiffen the ends of the joining members by diaphragms. Pin intersections in the web have special plates carried on the pin to give attachment for the stay members and the struts and diagonals of the sway system.

The top-chord eyebar joints merit attention for the arrangement of the riveted box embracing the pin, which forms the head of the built-up post or hanger and gives attachment for the upper laterals. This box was also utilized as a seat for the track beams of the creeper traveler, in the cantilever arm. Pairs of angles are riveted longitudinally on the upper plate for this purpose, to receive between them the webs of the track-beam shoes.

The methods of connecting the sway system to the web-members will be clear without explanation. Sway frames occur at all panel-points, and inclined frames or portals are used in the planes of the diagonals near the tower post (U8-L10, L10-U12) and at the ends of the cantilever arm (L16-U18) and the suspended span (L18-U20). The end posts of the anchor arm of course also have portal bracing.

SKID GIRDERS.—These girders are best seen in the cross-sections of the bridge, as in Figs. 4 and 8. They were originated by the Chief Engineer of the railway company and are now used on several of the Pittsburgh & Lake Erie bridges.

On each side of the bridge two horizontal lattice-girders, 5 ft. 4½ ins. deep (horizontally), placed respectively 4 ft. and 6 ft. above top of ties, with inner faces 6 ins. in from the inner face of truss, form effective fenders against derailed trains. The protection benefits the train as well as the bridge. The general effect is similar to that of Cassatt's concrete benches in the Pennsylvania R. R. tunnels under the Hudson River.

These skid girders are made up of T-shaped chords, each consisting of two 6 × 6 × ½-in. chord angles with 12¼ × ½ and 10¼ × ½-in. web-plate on track side and outer side respectively, and a web system of 3½ × 3½ × ⅜-in. angles. Rivets occuring on the track face are countersunk. The ends of the chords extend to the truss panel-point line, so that a continuous fender is formed. Shelf angles riveted to the posts of the bridge support the ends of the web-plates. Expansion joints are provided at

rvals along the skid girders to protect them m any undue stresses.

VEIGHT.—The weight of the bridge as de- ned and built is given by the following table:

	Lbs. Total.	Lbs. per lin. ft.
hor and Cantilever Arms (1,124 ft.):		
usses and bracing (including bearings and all anchorage details)	21,027,000	18,700
loor	3,455,000	3,075
Total	24,482,000	21,775
pended Span (285 ft.):		
usses and bracing	2,217,000	7,770
loor	875,000	3,075
Total	3,092,000	10,825
Total main structure	27,574,000	19,550
Approach span (370 ft.) (including floor)	4,412,000	11,930
Total steelwork of bridge	31,986,000	17,970

Note.—Ties, rails, etc., not included in these weights.

The construction work, including the special features of the shopwork and the erection, will be described separately in a later issue.

The Gold Dredging Industry.*

By CHARLES JANIN.

It is the contention of most engineers and operators familiar with the conditions, and is undoubtedly true to a great extent, that the limits of dredging areas in California have already been fairly well defined, and that the greater portion of the field is controlled by the large interests. Other engineers are more optimistic and believe that tracts which have previously been passed over, or reported on unfavorably, when prospected some years ago, still hold possibilities for the future. With the great advance made in the industry and the development of the modern dredge, from the earlier successful boats with their 600 cu. yds. per day capacity, to the boats with 16-ft. buckets and the estimated capacity of 300,000 cu. yds. per month, and the reduction of working costs, under favorable conditions, to less than 3 cts. per cu. yd., it is obvious that areas which a few years ago were considered too low grade to equip with a dredge will, under present conditions, again attract the attention of those interested in the dredging industry.

In Alaska there is a growing demand for dredges of the smaller class, having 2½ to 7 cu. ft. buckets, a number of which have been installed in the last year and several of which are planned for 1911. In addition to these smaller boats, the Far North can boast of one of the largest dredges yet constructed, a Marion 16-ft. bucket dredge installed on the Boyle concession in the season of 1910. This boat has a total weight of 900 tons and will dig approximately 10,000 cu. yds. per day. On this same property a Marion 7-ft. bucket boat has been successfully working since 1906 and is still in good condition; for the past season it is said to have averaged 3,700 cu. yds. per day.

Besides the possibility for new dredging areas in California, and other western states and in Alaska, the attention of dredge operators has been attracted to the many opportunities for the installation of dredges in foreign countries. Much interest has been manifested in Siberia of late, and a number of American engineers have been engaged during the past year in the examination of Siberian gravel properties. A number, if not all, of these examinations, resulted unfavorably, some on account of the low grade of the gravel, others because of severe business conditions or exorbitant prices imposed by the owners. However, there is no question that, so far as operating conditions are concerned, there are areas of gravel in Siberia that can be profitably worked. Recent reports from the dredges operating in Siberia show an increased working efficiency, both in the yardage handled and the percentage of gold recovered per dredge.

Recent engagements of experienced engineers for West Africa indicate that it is being more seriously considered as an attractive field for dredging investments. Some of the first dredges there, as in other fields, were failures, but the employment of competent men is the first step toward obtaining reliable knowledge of existing economic conditions, and securing the installation of suitable dredges when they are warranted.. This practice, if more often followed, would save investors much money and give a far better tone to the mining business in general.

It may be said that the majority of dredges placed in South America have been unprofitable. This has been due, in part, to a failure to recognize, or to properly appreciate, the difficulties of installing and operating a dredge under the conditions existing in South American countries, and in part to equipping a property with unsuitable dredges on ground the value of which was optimistically guessed at rather than determined by careful sampling.

The most important dredging work in South America is that on the property controlled by the Oroville Dredging, Ltd., on the Nichi River, in Colombia. The area was carefully examined by capable engineers, and is probably the first South American property to be drilled and prospected in the systematic manner in which such work is done in California. Over 300 acres were proved to be profitable dredging ground. The company has a concession of 22,000 acres, the greater portion of which has not yet been prospected. A hydro-electric plant has been built and an 8½-cu. ft. bucket dredge (California type), with steel hull, will be built.

In French Guiana, dredging has been tried so far on three rivers only, the Curcibo, the Sparwin and the Lizard. Three new dredges are in course of construction in those places, an indication that the first results, either in dredging or in prospecting, have been encouraging. There are in French Guiana other rivers equally rich. According to the latest reports, a new dredge operating in Roche Creek, carefully prospected in 1908, has given an output of 8 kg. in March and 10 kg. in April, 1910 (1 kg. of this gold is worth about $500). Experiments extending over a period of six months were made with an English dredge of 1,000 cu. m. estimated capacity a day, but which, owing to difficulties of operation, was unable to wash more than from 300 to 400 cu. m. in 24 hours. These experiments are said to have demonstrated that the cost of operation in handling this amount of gravel was from 36 to 42 cts. per cu. yd. Operating conditions are likely, however, to improve with further experience.

An entertaining account of the "Goldfields of French Guiana," by Albert Bordeaux, from which the above paragraph was abstracted, appears in the Trans. Amer. Inst. Min. Eng. for November, 1910.

In British Guiana, dredges are successfully operated where the gravel is much lower in gold content than that of French Guiana. It might be that better results could be obtained in French Guiana by employing convict labor, but thus far experiments in this direction have been far from encouraging; another attempt is to be made on a placer near S. Jean du Maroni.

In Dutch Guiana, gold dredging has been carried on along the Saramaca and Marowijne rivers with small Holland-built dredges.

In Mexico, several gravel areas have at times attracted attention. A dredge was installed at Suaqui Grande, Sonora, some years ago, but was not a success. Other places in Sonora along the Yaqui River, near Tonichi and San Antonio, were prospected with Keystone drills with indifferent results. A prospecting party is now drilling at the latter place, but reports from it are not encouraging. The dry placers of Altar have been brought into prominence recently by the success of the Quenner "dry-washing" machine. In Sinaloa there are places where it is claimed that the ground could be profitably dredged. The present outlook for gold dredging in Mexico, however, is not brilliant.

Among other fields that may be mentioned as offering possibilities for gold dredging are Korea, China, and the Philippine Islands. In Korea tests have been made of gravel areas and it has recently been reported that a dredge is to be erected. In China there has been no dredging, but engineers consider that there are areas in the northeastern part which are worthy of investigation. The only successful dredging in the Philippine Islands has been carried on in the Paracale district, which is situated in the northern part of the province of Ambos Camarines on the eastern coast of the island of Luzon. It has been described in "The Mineral Resources of the Philippine Islands," published by the Division of Mines of the Bureau of Science. The placer ground in the vicinity of Paracale generally consists of about four or five meters of barren clay mixed with organic matter overlying a varying amount of gray clay carrying small quantities of gold. Below this is an irregular layer of sand and quartz pebbles, in places showing large amounts of free gold. Dredging operations have been carried on by the Paracale Gold Dredging Co., a New Zealand corporation; the Stanley-Paracale Co., whose dredge is at present shut down, and the Philippine Gold Dredging Co., which bought a dredge originally erected on the island of Masbate. This latter dredge was found unsuited to the ground on the Paracale River, and was again moved ,this time to the Malaguit, where it is said to be successfully worked.

The Paracale River is really an arm of the sea, with a tide rise and fall of some 5 or 6 ft. The flat in which it runs is perhaps a mile wide near the mouth. It continues about the same width for a mile or more, and then spreads out into smaller flats with ranges of hills between. The total area available for dredging in this flat is estimated at 1,300 acres. The average depth is 30 to 40 ft. on the lower river; but higher, where the Stanley dredge is working, the depth is considerably less. The Malaguit River, which flows into the Pacific not far from the Paracale, has been prospected with hand drills. There is a much larger percentage of gravel and heavy material there than on the Paracale. Several other streams in the same district have been prospected to some extent, with results not altogether favorable. Low hills and ridges divide the tidewater streams, and, except where cleared by the natives for growing hemp, are covered with heavy timber and a dense undergrowth, so that prospecting is difficult.

In Burma there are numerous gravel areas, some of which have been worked for generations by the Burmese, who employed a rude method of ground sluicing. A number of these areas have been more or less thoroughly prospected, and several dredges have been built, a number of which were failures. According to J. Malcolm Maclaren, in "Gold, Its Geological Occurrance and Geographical Distribution,"

> Of all Burma's numerous auriferous alluvial deposits, none has been considered worthy of extended trial except those owned by the Burma Gold Dredging Co., above Myitkyina. There three dredges were at work in 1907 with results considered so satisfactory that a fourth dredge of greater capacity was being built.

Figures for the past year are not at present obtainable, but according to an article in "The Mining Journal," in November, 1909, these three dredges worked six days a week for an average of 46 weeks and turned over a total of 1,918,000 cu. yds. for the year, with a total recovery of £32,000, or 8 cts. per cu. yd. The operating cost, including management, is given at 3½ cts. per cu. yd. It is possible that dredges will be placed on other properties; a California type, Bucyrus, boat, has in fact been ordered by the Mewaing Gold Co., Ltd.

In Japan, according to a report recently issued by the Bureau of Mines,*

> from early times many placer workings have been carried on in the river beds or terraces along the river sides in the districts of Kesen, Wakuya, Hayakawa, Abekawa, Yoshinogawa, etc. Recently they have begun to be worked in many localities in the Hokkaido, and the River Kilung in Formosa. Up to the present time, only the surface placers have received attention, for which reason no gold dredging or underground working has been attempted. The largest nugget ever found in Japan weighed only 27.1 ozs., and was found in the gold-bearing gravel at Yesashi. The greater part of these deposits are in the Alluvium, while a few of them are discovered in the Diluvium, yet we never find any Tertiary placers.

In tropical countries there are many drawbacks that should be thoroughly understood by anyone purposing to invest in mining properties. Often rough mule trails are the only means of entering a district and the transportation of heavy machinery would be impossible until some kind of a road was built. Attempts to sectionalize dredges have not been as successful as with other classes of mining machinery. In Guiana the only means for transportation of machinery along the rivers is by canoe. One dredge failed to reach its destination because the hull pieces were too large to be taken over the first rapids. They are still to be seen along the trail. The attempt was made to remedy this loss by building a wooden hull on the ground, but in that climate insects and worms destroy wood in a short time. The next hull ordered was made in smaller pieces.

Climatic conditions in the tropics are generally trying; the heavy rainstorms during the long wet seasons, and malaria and beri-beri are to be contended with. The inefficiency of native labor is also a serious matter, though in some cases it has been possible to instruct natives to operate a dredge, with a white overseer in control. There is always difficulty in securing and maintaining an efficient and honest staff of white labor so far from home, and it is generally found necessary to have a reserve corps to fall back on when occasion requires.

One engineer, who has some interesting figures from an extensive examination in Colombia, mentions that his white assistants were incapacitated 16⅔% of the time from sickness. On another trip the young engineer in charge contracted a fever which proved fatal. In foreign countries, as elsewhere, in making investments in dredging, much money may be saved, and disappointment avoided, if prospective investors will insist upon having reports by experienced engineers rather than listening to the advice of optimistic incompetents, and going blindly into enterprises that, to be an economic success, require experience and good judgment in every phase of the work.

A SUSPENSION ELEVATED RAILWAY is proposed for Philadelphia, and a model of the system, which was patented in 1910, is on exhibition in the Bourse Building. The system uses two rails instead of a single rail, but the wheels of the truck which run on the two rails are on independent axles, and are therefore claimed to turn curves with much less friction than takes place on the ordinary railway. The system is being promoted by the B. & R. Rapid Suspension Ry. Co., of which Mr. James C. Chamberlain is Pres., and Mr. William A. Cowling, of the Western Engineering Specialties Co., Denver, is Engr.

*Condensed from an article in the "Mining and Scientific Press" of Dec. 31, 1910.

*"Mining in Japan, Past and Present," pp. 65. Bureau of Mines, Department of Agriculture and Commerce of Japan, 1909.

Elementary Principles of Irrigation-Lateral Construction.

By F. W. HANNA.*

There is no better evidence of excellency of design of an irrigation system than that shown by the proper location and design of its subcanal or lateral system. The dams, the large canals and the main structures appertaining to them are usually given careful thought in location, design and construction, but the lateral system is too often given scant consideration. The water user, however, is the man for whom the irrigation system is being built, and it means much to him in economy of operation and efficiency of water delivery to have a properly located and designed lateral system.

In addition to the alinement of laterals so as to reach the land to be served most economically and effectively, which was sometimes neglected in the early irrigation systems, but which is now quite generally done, there are important questions in connection with lateral cross-sections, velocities, grades, drops, grade protectors, checks, tap boxes and weirs that should have careful consideration.

CROSS-SECTIONS.—The laterals of an irrigation system are necessarily constructed in tillable soil and the material is, therefore, of such nature as to require side slopes of about 1½ to 1 or 2 to 1. The latter ratio is more convenient for construction purposes, as it greatly facilitates team work, particularly in the use of Fresno scrapers, while the former ratio gives a lateral section less productive of water losses. The relation of bottom width of a lateral to the water depth should be governed within certain limits by the fall of the country over which the lateral is being run. Where the fall is slight and it is desirable to carry a comparatively large depth of water on a small base width, the relation of bed width to depth of lateral can well be determined by the formula,

$$b = d^2 + 1,$$

in which b equals the bed width and d the water depth. Where fall is abundant and it is necessary to construct a wide shallow lateral in order to obtain simultaneously proper velocity and economical excavation, the relation of bed width to depth may be determined by the formula,

$$b = 2d^2 + 2.$$

These formulas may be considered as giving approximately the maximum and minimum limits of bottom widths for given depths of water. While the formulas are likely to give fractional bottom widths, it is considered best to use integral values in the design of the lateral cross-sections. Ordinarily, a minimum limit of about 0.5-ft. should be placed on d and 3 ft. on b, except for V-shaped ditches.

Experience and measurements on the Payette-Boise project, Idaho, as well as observations on many other irrigation projects, indicate that the value of n in Kutter's formula should not be taken higher than 0.0225 for determining the velocity in laterals running through agricultural soils forming unctuous, sandy or silty channels. It is probable that the actual value of this coefficient is in some cases less than this quantity and it is quite certain that a higher coefficient of roughness will result in too high velocities while the laterals are new. In gravel, hardpan and other rough channels n should be assumed to have the value of 0.025. As the banks of the channels become grown up with weeds, the coefficient of roughness increases so that from 10 to 25% excess capacity should always be provided in designing laterals. The grades of laterals and their cross-sections should be so selected as to give velocities applicable to the soils through which the laterals run. A velocity of about 2 ft. per sec. for light sandy loam, 2.25 for loam and 2.50 for resistive hardpan will protect new laterals from excessive erosion without seriously endangering them to silting and moss growth.

DROPS.—Owing to the limited relation of bed widths to water depths of laterals, it becomes necessary to establish drops in the grades of laterals at various intervals where the laterals cross steep country. In carrying the grades of such laterals, the necessary drop not taken up in the uniform grades should generally be absorbed by a number of small drops rather than by a few large ones. This is true for several reasons: in the first place, the lateral grades can be brought to, or near, the ground surface at frequent intervals selected for tap-box locations so that the water may be as near the ground surface as possible. By carefully manipulating the drops on many laterals, with reference to tap-box locations, satisfactory results can be obtained in the delivery of water to the land without the use of checks; again, by the use of small drops difficult excavation usually encountered in connection with large drops can be obviated; finally, by using a number of small drops, advantage can be taken of a simple type of structure not requiring approach and outlet aprons.

In some cases it may be desirable to construct laterals on grades that are certain to result in erosive velocities, in which event grade protectors should be placed immediately below the tap boxes so as to prevent them from being left high after the erosion takes place. These grade protectors may be made of very simple construction and are not to be considered as checks as it is not their function to check the water above its normal level in the laterals, their function being that of holding the grades of the laterals to their normal level in the vicinity of water delivery points.

TAP BOXES.—In the location of tap boxes it should be held as the first principle that all tap boxes should be so placed as to eliminate the necessity for checks, not only for a full-supply level of the lateral, but for a half depth as well, or even less, in large deep laterals. Where the lateral is carried well above the ground surface, it is usually expedient to place the tap boxes somewhere on the property that they are to supply, preferably, conditions permitting, at the upper property line. If the lateral is well below the ground surface, it will be necessary to take the water out of it at some distance above the property that it is to serve, thus gaining the advantage of a drop in the lateral or the use of a flat grade in the farm ditch in order to get the water high enough to properly serve the land. Where the principle of bringing water from the main lateral out of a tap box above the property fails for any legitimate reason, for any considerable area, and this reason should be a good one, then the check system should be resorted to. It is desirable, so far as practicable, to set all tap boxes so that the bottoms of their discharge outlets will be some 0.5-ft. below the grades of the laterals regardless of the proposed elevations of the water surfaces in the farm ditches. Water will then always be accessible to the tap boxes and the elevation of the weir crests may be used to control the outside water elevations. The setting of tap boxes below the lateral grades is especially necessary in pipe structures. It is desirable, so far as practicable, both from the water users' standpoint and the operator's standpoint, to supply each user with but one tap box. This arrangement requires less operating expense and gives the water user the advantage of having at command his full flow of water at all times for use on all or any part of his land. Where a tract is divided by the lateral the water may readily be transferred to the opposite side of the lateral from which it is taken by means of either a flume over it or a siphon under it.

WEIR CRESTS FOR TAP BOXES.—In setting weir crests for tap boxes, knowledge should be had of the land to be covered, of the position of the connecting farm ditches and, to a certain extent, of the wishes of the parties receiving the water. Ordinarily, it should be assumed that it will be required to supply a full flow of water to the tap boxes when there is some particular fractional depth or discharge of water in the laterals, such as, for instance, one-half normal water depth or one-half discharge. When the land to be watered is well below the assumed water-surface elevation in the lateral, there will be no difficulty in placing the weir crests sufficiently low to permit the proper discharge of water over them and yet, at the same time, sufficiently high to permit the delivery of water to the land to be irrigated. Where, however, economy of fall is essential for covering high areas, either at a distance or adjacent to the laterals, careful consideration should be given to the elevations of the weir crests. In determining what lands can be watered from the laterals, the beginning should be made with the elevation of the assumed water surfaces of the laterals, as above stated, and the weir crests set just low enough to allow for the proper depth of water over the weirs and the loss of head due to entrance, friction and velocity through the tap boxes. Drops in lateral grades below the weirs to prevent weir submergence and fall for conducting the water from the weirs to the land should be provided.

Each one of these elements of fall is, within certain limits, under the control of the engineer in laying out the lateral system. The loss of head in delivery of water from the laterals to the weirs can be decreased by increasing the size of the tap boxes; the depths of water over the weirs can be decreased by using long weirs; the amount of drop to be provided below the weir can be controlled by using a wide shallow ditch inasmuch as this drop must equal in height approximately the difference between the elevation of the weir crests and the ditch grades. The grade of the ditch can be made as flat as possible for conducting the water to the proper point. Precautions having been taken to use the minimum economical fall in all of these places, small tracts of land slightly too high to be reached in this manner without the use of checks should be leveled down, where soil conditions will permit.

The pools should always be amply large in cross-section to give a low velocity of water through them in order to insure accurate measurement. The lengths of the pools need not necessarily be very great for small quantities of water and the distance of the weirs from the tap boxes should depend a great deal upon local conditions. If the water is let out from the main laterals under low heads, the weirs need not be over 15 or 20 ft. from the tap-box outlets. On the other hand, if the water is let out under high heads, the weirs should be fully 50 ft. from the tap boxes so as to permit such quiescence of the water as to insure accurate measurements. Each weir pool is, therefore, a problem in itself that must be studied carefully by the party locating and constructing it, as well as the party operating it.

Other things being equal, it is best to place the weirs directly in front of the tap boxes. Where the emitting velocity is high, necessitating the placing of the weirs at long distances from the tap boxes, the pools may be placed parallel to the canals themselves in order to obviate waste of land in and around the weir pools adjacent to the laterals. Careful study should, of course, be given to the situation before deciding upon this kind of location, as there will always be more or less wear on the laterals at the turns, resulting in silting the pools unless protected by riprap or the water is turned by a right-angle extension of the tap boxes. The pools should also in such cases be placed well below the turns so that the water will have ample distance to aline and quiet itself in before coming on to the weirs.

CHECKS.—As already intimated, the use of checks should be obviated as far as practicable. In addition to minor difficulties, there are three very important reasons for this: (1) checks cause the laterals to become filled with silt that should be carried onto the land for fertilizing purposes and that must be removed from the canal from time to time at considerable expense; (2) they offer most excellent means for dishonest water users to get more than their share of water either directly through their own actions or indirectly through collusion with ditch riders; (3) the use of checks for getting water out onto high areas very often results in danger to the integrity of the laterals themselves, particularly when the checks are located immediately below high fills. Checks are, however, a necessary evil that must be used when laterals are to be operated at considerably less than full capacity, as is so often

*Project Engineer, Payette-Boise Project, U. S. Reclamation Service.

case for a portion of each irrigation season in most irrigation systems and when large bodies of land can be successfully served only by the use of the check system.

LATERAL BANKS.—The design of a lateral bank is an elementary problem in the design of earth dams. The distinctive feature of the lateral bank is the smallness of the structure, which requires the fixing of minimum dimensions rather than a broad consideration of the principles of stability. The bank of a lateral should have a freeboard above the high-water line, varying from about 1½ to 2 ft. where the water line is above the natural ground surface, to obviate water pressure on the porous surface layer of the bank and to provide for unexpected rises of water from any cause. Where the high-water line lies below the natural ground surface, due to a deep level or side-hill cut, the freeboard may be reduced to 1 ft. or less, depending on local conditions. The crown, or top width of the bank, may ordinarily be taken at about equal to the height of bank, with a minimum limitation of 3 ft. where the water line is above the natural ground surface and 2 ft. where the water line is below the natural ground surface or the lateral is very small. In providing for a berm between the edge of the canal slope and the waste material, it is a good rule to make the width of this berm equal to the vertical height of the cut. In building the lateral banks, allowance for settlement should be made. In making this allowance the height of bank should be increased about 10%, and the top width likewise about the same outwardly, the other dimension being unchanged. In making provisions for settlement as outlined, there will be no danger of diminishing the carrying capacity of the lateral.

WATER LOSSES.—The design of the capacity of an irrigation lateral is intricately connected with two most complicated problems, namely: losses and duty of water. Capacity increases with losses and the effect of this factor in design is a varying one from the end of the last lateral up past the various branches to the head of the main canal. Duty of water affects capacity directly in the quantity of water that must necessarily be delivered on the land. In addition to these two factors affecting the capacities of canals and laterals, the effect of growth of moss and vegetation on the banks and beds of canals and laterals demands consideration.

Investigations have been made to determine seepage losses in canal systems, and a most interesting table of results has been brought together in Saville's report on the Gatun dam. [See Eng. News, Dec. 24, 1908, p. 723—Ed.] This table shows a daily seepage loss in cubic feet of water per square foot of wetted area varying from 0.23 to 6.4. The greatest number of the experiments, however, show a rate of seepage varying from 0.4 to 1.5 cu. ft. per sq. ft. of wetted surface per day. These figures in this table agree approximately with results obtained by Allen Hazen* for average conditions under which seepage would occur. It would appear, therefore, that a seepage loss of 0.5, 1 and 1.5 cu. ft. per sq. ft. of wetted surface per day might be assumed, respectively, for relatively impervious, mediumly impervious and relatively pervious soils.

Assuming an average relation of bed width to depth of water in laterals to be given by the formula

$$b = 1.5\ d^2 + 1.5,$$

a mean velocity in feet per second of 2 and side slopes of 2 to 1, a table of losses in per cent. of flow per mile of lateral can be compiled as shown in Table I.

TABLE I.—Losses in Irrigation Laterals Expressed in Per Cent. of Flow Per Mile of Lateral.

d	b	A	p	L	Q	P C=0.5	P C=1	P C=1.5
0.5	3	2	5.24	0.31	4	4.0	8.0	12.0
1.0	3	5	7.48	0.45	10	2.3	4.5	6.8
1.5	5	12	11.72	0.70	24	1.5	2.9	4.4
2.0	8	24	16.96	1.02	48	1.0	2.1	3.1
2.5	11	40	22.20	1.33	80	0.8	1.7	2.5
3.0	15	63	28.44	1.71	126	0.7	1.4	2.1

In the above table, d equals water depth in feet; b lateral bottom width in integral feet with a minimum limit of 3; A, area of water cross-section in square feet; p, wetted lateral section per linear foot in square feet; L, seepage loss in second feet per mile of lateral for C equaling 1; C, the rate of seepage in cubic feet per square foot of wetted surface per day; Q, the lateral discharge in second feet; P, the per cent. of loss of flow per mile. By use of these symbols it may be shown that $L = 0.06\ C\ p$ and $P = 6\ C\ p \div Q = 100\ L \div Q$.

Inasmuch as computations on seepage losses are necessarily rough approximations, the general values for use in the design of lateral capacities given in Table II. will be sufficiently accurate and sufficiently large also to account for evaporation losses.

TABLE II.—Values for Designing Irrigation Laterals.

Lateral capacities in sec.-ft.	Lateral class designation.	Losses in per cent of flow per mile for C = 0.5.	Losses in per cent of flow per mile for C = 1.	Losses in per cent of flow per mile for C = 1.5.
10 or less	1	4.	8.	12.
11 to 25	2	2.5	4.5	7.
26 to 50	3	1.5	3.	4.5
51 to 75	4	1.	2.	3.
76 to 100	5	0.75	1.5	2.5

The office of Experiment Stations, U. S. Department of Agriculture, in one of its circulars, gives the following values as a result of all of its experiments, including numerous measurements made during a long series of years: for canals carrying more than 100 sec. ft., 0.95%; between 50 and 100 sec. ft., 2.58%; between 25 and 50 sec. ft., 4.21%; less than 25 sec. ft., 11.28%. For data based on a multiplicity of varying conditions, it will be noted that these results agree quite well with those arrived at in Tables I. and II. The figures of this table may, therefore, be relied on to give fair average values, for the lateral velocity and side slopes assumed, for soils of varying degrees of imperviousness in average conditions with sufficient accuracy for lateral design. Similar tables to those above given can readily be made for other lateral side slopes, velocities and relations of bed width to water depth, to suit the particular design of lateral used.

DUTY OF WATER.—The duty of water is dependent upon the climate, the soil and the character of crops raised as well as on the skill and labor in its use. For a long growing season there must be, of course, a very large quantity of water used, whereas for a short season the quantity of water required for crops may be comparatively small. Crops requiring only a small amount of water throughout the season tend to produce a high seasonal duty of water, as do likewise crops that require only a part of a season in which to mature. In the Boise Valley, it may be assumed for designing purposes that small grain crops require about 1½ acre-feet of water for maturity, orchards about 2 acre-feet and alfalfa and pastures about 3 acre-feet. A farm, therefore, planted one-fourth to small grain and vegetables, one-half to alfalfa and pasture and one-fourth to orchard would require approximately 2.5 acre-feet of water delivered on the land during the irrigation season. The duty of water would not be constant throughout the season, resulting in a non-uniform distribution. For the condition of crops and water-supply in the Boise Valley, the following might be assumed: 2% of the whole amount in April, 21 in May, 22 to 26 in June, 26 in July, 15 to 19 in August, 9 in September and 1% in October. It will be noted that the maximum rate of delivery based on this assumption and a seasonal duty of 2.5 acre-feet results in a maximum duty of about one second foot to 95 acres of land for June and July. By decreasing the maximum duty for 10% loss in the farm laterals, the final duty to be considered in the distributary design is about one second foot to 85 acres. Other variations in the monthly duty might be considered advisable from some view points, but the maximum rate of delivery would probably remain the same, which is sufficient for the purpose here sought.

Consideration having been given to the duty of water, the rate of seepage and evaporation losses and the area to be served under the various tap boxes preliminary capacities may be determined. In this determination the beginning should be made at the first tap box on the lower end of the lateral at the head of the last farm ditch in the system and the discharge computed for the lateral for the section immediately below the second tap box by means of the formula,

$$Q = A \div D\ R^m\ r,$$

in which Q is the desired preliminary discharge in second feet at the upper end of the stretch under consideration, A the area in acres served, D the computed duty of water at the head of the farm ditch, R an abstract number representing 100% minus the loss per mile in per cent. for the lateral class under consideration divided by 100, m the integral portion of the length in miles of the stretch of lateral under consideration, and r, 100% minus the proportional part of the loss per mile in per cent. divided by 100 for the excess fractional length. The required discharge through the second tap box may be found by dividing the area by the duty of water if it is at the head of a farm ditch, and, if it is not, the discharge should be determined in the manner outlined for the main lateral. This discharge should be added to the discharge determined for the main lateral below the tap box, which, together give the capacity at the lower end of the next stretch. The discharge in the main lateral below the third tap box may now be computed by the following formula:

$$Q = Q^1 \div R^m\ r,$$

in which Q equals the required discharge, Q^1 the discharge at the lower end of the stretch, R, m and r the significance already given them. Thus the process proceeds up the lateral, noting the proper changes in the value of R and r for the corresponding changes in character of soil and class of lateral.

To counterbalance the effects of vegetation and the consequent varying increase of the coefficient of roughness in laterals of different sizes, the capacities of the laterals as thus computed should be increased about as follows: Class 1, 25%; class 2, 20%; class 3, 15%; classes 4 and 5, 10%.

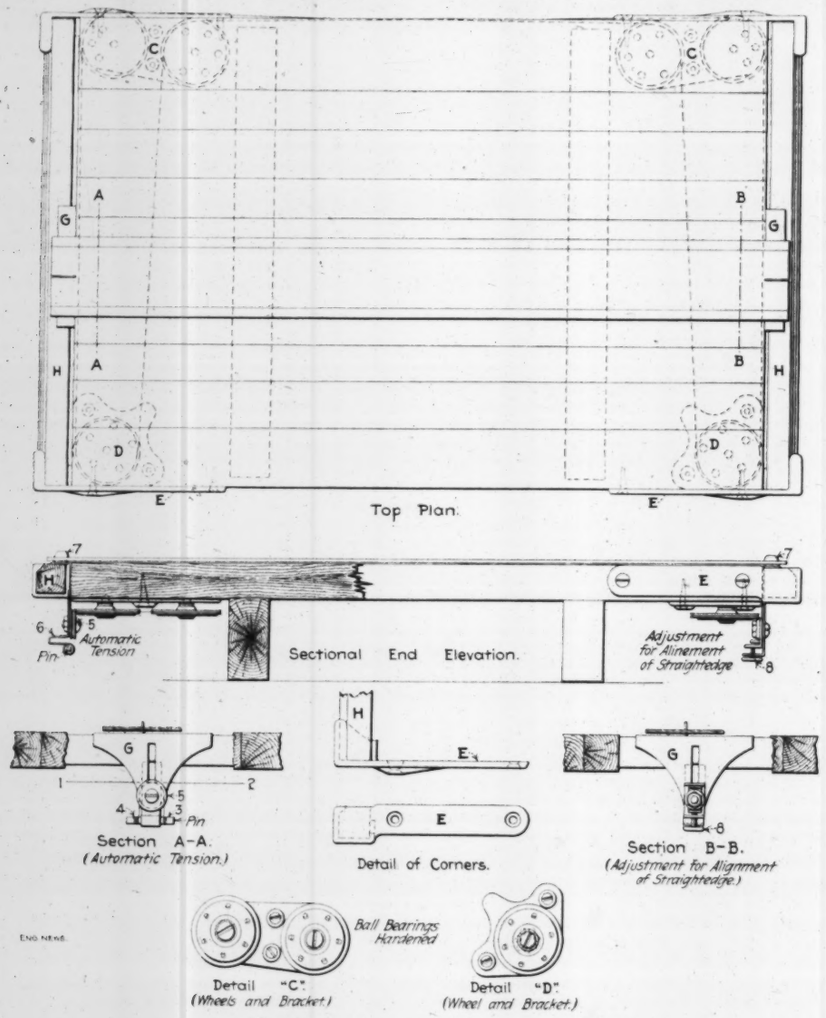
From the foregoing principles, it is clear that no general duty of water can be assumed in designing lateral capacities, as the effects both of losses and of increases for roughness coefficient depend on the general shape of the distributary system, being much different for a long narrow tract of land with farm taps on the main lateral than for a wide short tract of the same area with large sub-lateral turnouts intermingled with farm taps. There are also cases where it would be desirable to change the assumed rate of percolation, owing to a marked change in soil imperviousness. Careful computation for capacity should, therefore, be made before construction of the lateral takes place. A general duty may, however, be assumed for use in running out the lateral alinement and grades, which, for the duty of water on the land herein assumed, should vary approximately from about one second foot to 50 acres to one second foot to 60 acres, in accordance with the nature of soil imperviousness, the shape and extent of the lateral system and the position of the stretch of lateral under consideration in the system.

*Report of Massachusetts State Board of Health for 1892, p. 541.—Ed.

THE HIGHEST BUILDING IN THE WORLD is to be erected in New York City on Broadway, between Barclay St. and Park Pl., facing the old U. S. Post Office and City Hall Square. As announced in Engineering News, Nov. 24, 1910, p. 581, it was originally intended to erect on the corner of Park Pl. a building 26 stories high in the main section, with a tower extending 19 stories farther, to a total height of 625 ft. Recently, however, the owner, Mr. F. W. Woolworth, of "5 and 10 ct. store" fame, has purchased the remaining Broadway frontage of the block, and it is now announced that the main building will extend from Park Pl. to Barclay St., and will be 30 stories high, surmounted by a central tower, some 85 ft. sq., rising 25 stories higher, making a height of 55 stories and 750 ft. The Metropolitan tower, at Madison Square, New York City, at present the highest building in the world, outside of the Eiffel Tower at Paris, is but 50 stories and 700 ft. high. The Woolworth Building will cover a total area of 39,500 sq. ft., and will have a floor area greater than any other office building in the city. Mr. Cass Gilbert has the architectural design in charge.

Improved Parallel Straight-Edge for Drawing Boards.

The idea is not new of arranging a straight-edge to move always parallel to itself by means of a cord or wire attached to its ends and guided over a suitable set of pulleys. Such devices have been on the market for some years but have not come into very general use. Probably one reason why they have not been more widely adopted has been the inferior design, materials and workmanship not infrequently met with in this sort of device. The aim, of course, has been to keep the price down, but the success of the carefully constructed and comparatively high-priced Universal Drafting Machine has demonstrated that there is a demand for really convenient and well-made drawing implements of this description.



A NEW PARALLEL STRAIGHT-EDGE FOR DRAFTSMEN.

The accompanying illustration shows a set of attachments for a parallel straight-edge which was designed to be as accurate, easy-running and durable as the best of materials and workmanship could make it. These attachments were made in the first place for use in the offices of Boardman & Matteson, mechanical engineers, 86 Weybosset St., Providence, R. I. They have proved so satisfactory there that arrangements have recently been made for their regular manufacture.

The most notable improvement is the use of hardened steel pulley wheels running on ball bearings. These are expected to give much better service with less wear than the commonly used brass wheels on plain pin bearings. Six wheels are used, two at each upper corner and one at each lower corner of the board. The arrangement is well shown in the illustration. The wheels are mounted on flat metal brackets which are attached by woodscrews to the under side of the board.

In place of the braided wire cable sometimes found in such devices, a single steel wire is used of a special grade chosen for its combination of strength and flexibility. Constant tension in the wire is obtained by means of an automatic device at the left-hand end of the straight-edge. The operation of this device can be understood by referring to the illustration. The slide *G* carries, adjustably for different thickness of boards, a small, grooved washer (5) and a steel spring (6). One end (1) of the wire is lead over the top of washer (5) and wound around a pin which is frictionally secured to spring (6). The wire end is finally fastened at (3). The other end (2) is lead over the top of washer (5) and wound around the pin and fastened at (4). By turning this pin, the wire may be tightened or loosened to the desired tension and the spring will take care of the shrinkage or swelling of the drawing-board. Without this automatic regulation, swelling of the board might break the wire or shrinkage allow the ends of the straight-edge to vary because of too slack a wire.

The straight-edge may be adjusted horizontal or to any slightly inclined position by means of the attachment at the right-hand end. The right-hand slide *G* is clamped to the wire by means of the thumb screw (8). By releasing this screw the slide can be moved along the wire through a small distance limited by the length of the straight-edge. If too great an angle is attempted, the straight-edge will not be found long enough to extend from one slide to the other. The clips (7), by which the straight-edge is attached to the slides at each end, are pivoted so as to permit the straight-edge to assume a [illegible] angle when the thumb screw (8) is released. reclamping the slide to the wire, the straight edge is constrained to move parallel to the [illegible] position. The straight-edge may be quickly parallel with lower edge of drawing-board by [illegible] leasing the right-hand end from the wire, above, sliding the straight-edge and fitting down to the stops at the bottom of the board [illegible] then clamping it again to the wire.

The corner and end fittings consist of [illegible] brackets *E* and the hardwood ways *H*. The[illegible] prevent lateral movement of the straight-edge and provide supports for the slides *G* and protection for the wire along the ends of the drawing-board. As supports for the slides and [illegible] connection with the slots in the ends of the straight-edge, they permit the removal of the straight-edge from the drawing-board without disturbing any adjustments. The slots in the ends of the straight-edge, which receive the clips (7) of the straight-edge fittings, enable the straight-edge itself to be quickly and easily removed, leaving the entire surface of the drawing-board free.

The ease with which the straight-edge can be removed from the board and remounted again is of much importance. In beginning work on some old drawing, the procedure would be as follows: remove the straight-edge, tack drawing down in an approximately parallel position with reference to the lower edge of the board, replace straight-edge, loosen adjusting screw (8) and aline the straight-edge to the required lines of the drawing; then tighten the screw (8) and the straight-edge is ready for use.

Mineral Production of Alaska in 1910.*

The value of the mineral output of Alaska in 1910 is estimated at $17,400,000, compared with a value of $21,146,423 for 1909. The estimated gold output for 1910 has a value of $16,360,000 compared with $20,371,078 in 1909. The copper production for 1910 is believed to be about 5,600,000 lbs., valued at $740,000, compared with 4,124,705 lbs., worth $536,211 in 1909. The value of the other mineral products, such as silver, lead, gypsum, marble and coal, is estimated at $300,000—a small increase over 1909.

The decrease in the mineral production is chargeable to the falling off in the output of the Fairbanks, Seward Peninsula and some of the smaller placer districts. Except in these localities and in the coal fields, the output from all the mining districts increased. Much work was done on the copper deposits, and preliminary work to installing large mining plants for working low-grade gold deposits.

The lack of cheap fuel is still the great hindrance to the advancement of the mining industry. Coal prices vary from $8 to $20 a ton along the Pacific seaboard, so that mines located at tide-water even are at a great economic disadvantage, and only the richest and largest ore bodies can be profitably worked.

Practically nothing was done in the coal fields except to complete a few patent surveys. Some new drilling was done in the Katalla oil field.

The railways are at a double disadvantage in having to pay from $11 to $12 a ton for coal, which should cost only $2.50 to $3.50, and in not having the coal-hauling business, which would help to support them. The Copper River Ry. has completed the construction of its line as far as Chitina, where it has placed a temporary bridge across the Copper River. Only 60 miles remain which is to be built at an early date. Most of the other railway projects are dormant, awaiting settlement of the coal-land questions.

The Valdez-Fairbanks trail has been converted to a wagon road, which will aid the development of several mining districts between these places.

There were 13 productive gold-lode mines in operation in Alaska in 1910—one more than in 1909. A large amount of prospecting was done in the region tributary to Port Valdez, Cordova, Kenai Peninsula and Fairbanks.

There were seven productive copper-lode mines in 1910—the same as in 1909. The production is about equally divided between Prince William Sound and the Ketchikan Districts. The work accomplished in several districts has progressed far enough to show that Alaska will become an important copper producer eventually.

Though much of the richest placer ground in the older districts has been worked out, there still remain enormous bodies of gravel whose values are too low to permit working under present conditions.

*From a preliminary statement made by the U. S. Geological Survey on the mineral resources and production of Alaska for 1910. Complete and accurate statistics of production of Alaska cannot be collected for four or five months after the close of the year, but the figures quoted are believed to be within 5% of the actual production.

The U. S. Government Work on the Colorado River Break.

[Contributed.]

Readers of Engineering News will probably remember the disaster caused by the Colorado River some four years ago when it left its bed and poured its flood into Salton Sea. The river was finally restored to its bed after several unsuccessful attempts had been made to close the break.*

bed a short distance above its mouth. Some fifty miles of the main river bed were left entirely dry. The break, although in Mexico, threatened disaster to some 15,000 people in Imperial Valley, California. Congress, in June, 1910, placed $1,000,000 in the hands of President Taft for remedial purposes.

In July, 1910, Mr. J. A. Ockerson, M. Am. Soc. C. E., member of the Mississippi River Commission, was selected by President Taft as an expert on work relating to alluvial streams to make an examination and report as to means for restoring the river to its former bed and also preventing a recurrence of the break by confining the stream to its natural bed.

A survey covering some fifty miles of the river was made during the months of August and September, 1910, in spite of the excessive heat which had an exceptional record even for this torrid summer climate. Temperatures of 120° in the shade were reached.

Plans were developed for diverting the river back to its former bed and preventing future breaks to the westward by means of a levee about twenty-five miles long near the west bank of the river.

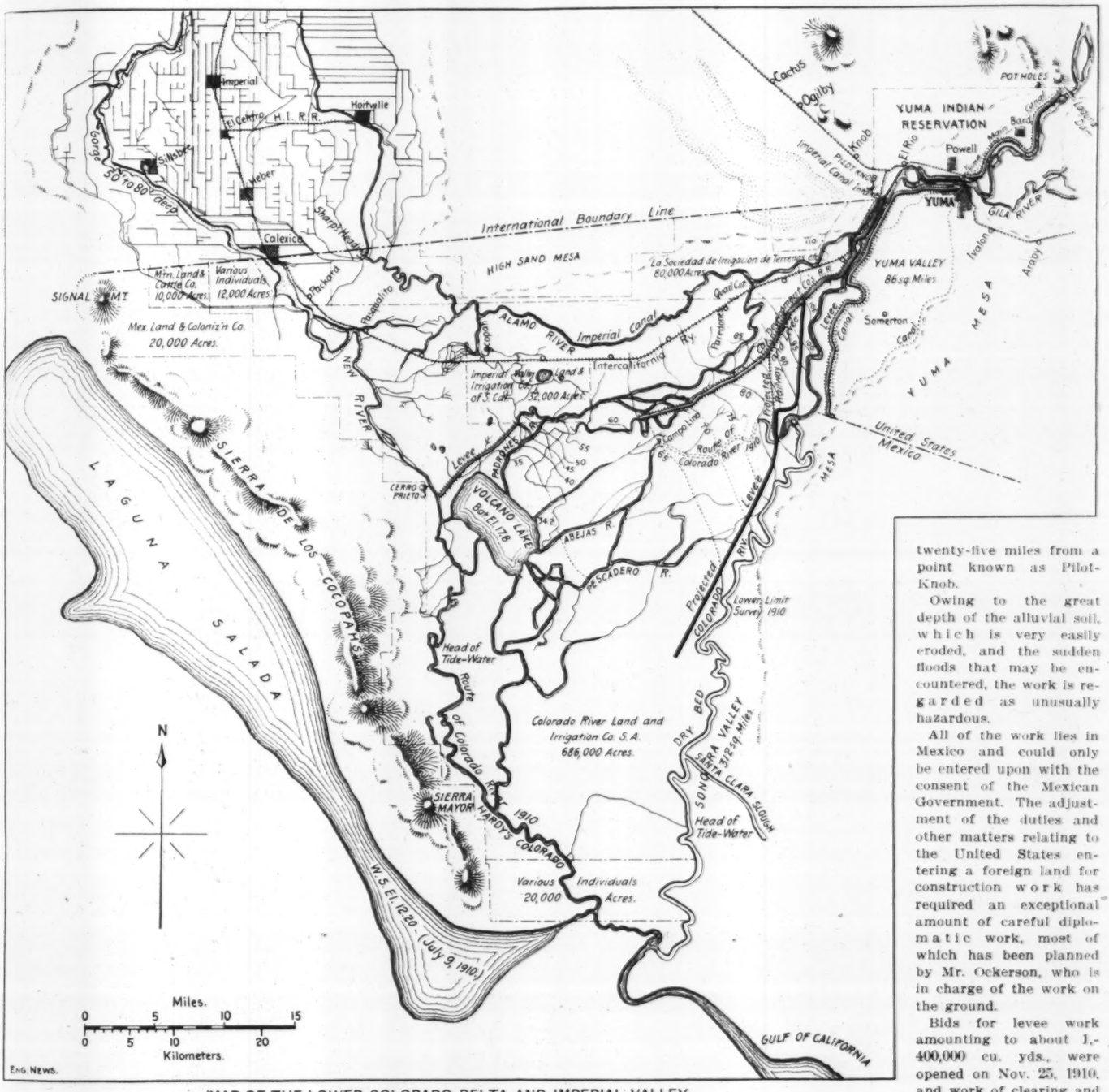
The closure of the break involves the construction of a standard gage railway some eight miles long, building a trestle across the river and dumping therefrom earth and rock to form a dam of sufficient dimensions to prevent its being overtopped or breached.

The material for the dam must be hauled about twenty-five miles from a point known as Pilot-Knob.

Owing to the great depth of the alluvial soil, which is very easily eroded, and the sudden floods that may be encountered, the work is regarded as unusually hazardous.

All of the work lies in Mexico and could only be entered upon with the consent of the Mexican Government. The adjustment of the duties and other matters relating to the United States entering a foreign land for construction work has required an exceptional amount of careful diplomatic work, most of which has been planned by Mr. Ockerson, who is in charge of the work on the ground.

Bids for levee work amounting to about 1,400,000 cu. yds., were opened on Nov. 25, 1910, and work of clearing and grubbing is under way. Grading the railway line is nearing completion and track laying began on Jan. 8, 1911. It is hoped to complete the entire work before the advent of the Spring floods of 1911.



MAP OF THE LOWER COLORADO DELTA AND IMPERIAL VALLEY.

(Showing the Imperial Canal, the course of the Colorado River, its high water outlets and the general alinement of works for the purpose of protecting the lands and property of the Imperial Valley. Compiled from various existing maps supplemented by surveys along the Colorado River made under the direction of J. A. Ockerson, Consulting Engineer, in August and September, 1910.)

A similar condition developed some twenty miles farther down the river, following the great flood of 1909, and after the high-water of 1910 the entire volume of the river passed down the Abejas River (see map), a high-water outlet, through Volcano Lake, the Pescadero and Hardy rivers and finally reached the Colorado River

*[See Eng. News, Feb. 22, 1906, p. 216; Mar. 15, 1906, p. 300; May 10, 1906, p. 512, for articles on the break, and Dec. 27, 1906, p. 671, for an article by H. T. Cory, M. Am. Soc. C. E., on the struggle which finally resulted in successful closure.—Ed.]

CLASSIFICATION OF PUBLIC LANDS by the U. S. Geological Survey is reported in a recently issued bulletin. The total area classified as coal land at the close of the year 1910 was 14,682,839 acres, valued at $625,944,830. The total area now withdrawn as coal land is 81,449,223 acres. There are now withdrawn as oil land 4,487,819 acres. To protect water-power sites, 1,423,561 acres are now withdrawn.

Twelve Years Development of Rapid Transit In Boston: The Extensions and Additions of The Boston Elevated Railway Co.

The Boston Elevated Railway Co. was first chartered in 1894, and the charter was amended in 1897. It authorizes building, leasing and operating surface and elevated street-railway lines, in and about Boston, and for furnishing rapid transit generally in the Metropolitan district. The company assumed charge of the consolidated system, from which the present one has grown, in January, 1898. In September, October and November, 1910, the company published a series of maps with explanatory notes, in the Boston daily papers, as a part of its policy of publicity, and to show the developments completed, underway and proposed. These maps and notes have recently been reprinted in pamphlet form for convenient preservation and consultation. The following summary has been taken from this pamphlet with a few data obtained directly.

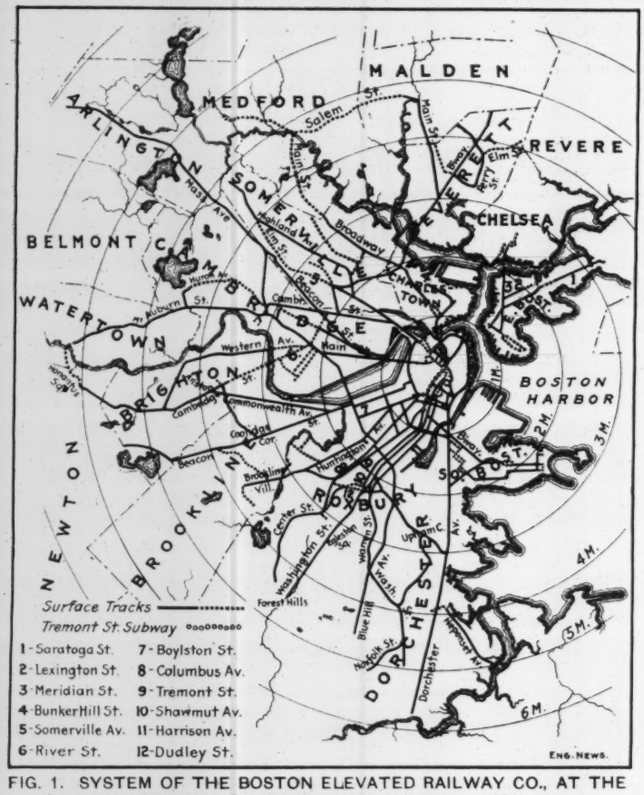


FIG. 1. SYSTEM OF THE BOSTON ELEVATED RAILWAY CO., AT THE BEGINNING OF OPERATION JANUARY, 1898.

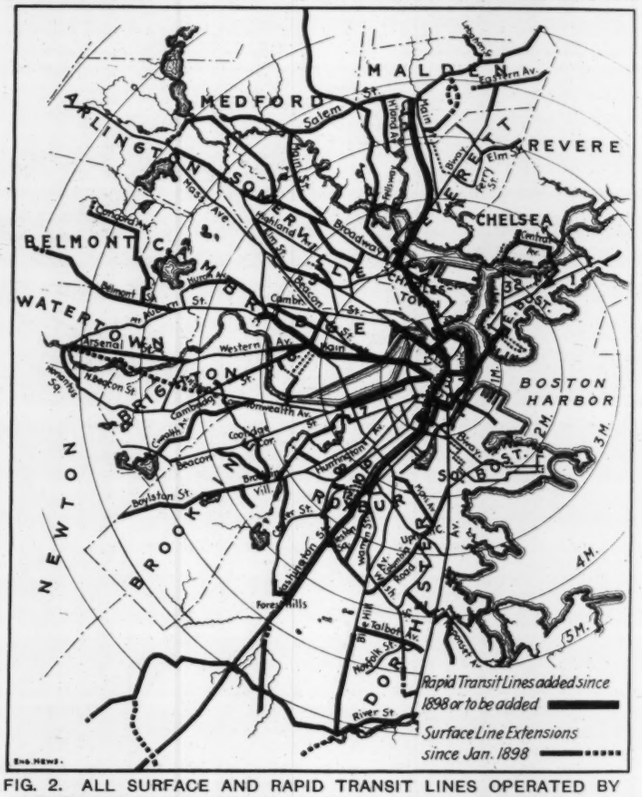


FIG. 2. ALL SURFACE AND RAPID TRANSIT LINES OPERATED BY THE BOSTON ELEVATED RAILWAY CO., AT THE END OF 1910.

It appears that when the company began operations in 1898, the population of the district served was about 843,000, including the whole or portions of Boston proper, East and South Boston, Charlestown, Chelsea, Everett, Malden, Somerville, Medford, Arlington, Cambridge, Watertown, Brighton, Brookline, Roxbury and Dorchester. To-day the territory is substantially larger and includes Belmont and other suburban districts. The population is approximately 1,100,000, an increase of 30%. In 1898 the investment of the company was $25,960,000, compared with $81,440,000, for to-day, an increase of 213%. The company has stated that absolutely none of this investment came out of the earnings, and that the stockholders have paid in $5,225,000, in premiums on stock, all of which has been invested in property but on which no dividends are paid.

The first great advance was the completion of the original double-track elevated line from Sullivan Sq., Charlestown, to Dudley St., Roxbury, in 1901. An elevated structure could not well be erected through the crowded business streets so it was placed on Atlantic Ave., along the eastern waterfront. In addition, trains were operated through the Tremont St. subway, a more direct line under the business section of Boston. The Tremont St. subway however was intended for surface cars and was diverted from its intended use to reduce the delays of waiting for additional tunnels for the "Elevated." The time between the terminals named was cut from 45 to 21 minutes and more convenient connection was furnished between North and South Stations (Boston and Maine, and New York, New Haven & Hartford R. R. terminals, respectively). The cost of the elevated lines, 5⅞ miles, was $20,300,000, including real estate, stations and equipment. The cost of the subway, 1 1/3 miles double track and ⅛ mile four track, was $4,200,000.

The second great step was the East Boston Tunnel, claimed to be the first structure built under tide water for surface cars. It carries a double-track line connecting Maverick Sq., East Boston, with the Atlantic Ave. Elevated, with the Tremont St. Subway and with the Washington St. Tunnel (completed later). The time from Maverick Sq. to the old State House (1½ miles) was reduced from 30 to 5½ minutes, and 60 cars per hour are being operated in rush hours with a possible increase to 180. This tunnel was opened Dec. 30, 1904, and it cost with equipment $3,500,000. It was built mainly in stiff clay and there were no land damages.

The third step was the opening in 1908 of the Washington St. double-track tunnel, one mile long. This carries certain of the "elevated" trains under the principal streets of Boston and permitted restoring the Tremont St. subway to its intended use for surface cars. It further reduced the time between the Sullivan Sq. and Dudley St. terminals to 18½ minutes. It became possible to use up to eight-car trains and the capacity of the elevated line was thereby increased 70%. This tunnel, however, is claimed to be the most expensive mile of railway line in the world, costing $10,000,000, with equipment. It was built mostly by "cut-and-cover" methods. (See Eng. News, April 19, 1906; Oct. 7, 1909).

A fourth step in these rapid-transit developments was the extension of the double-track elevated structure in 1909 southwest from Dudley St., Roxbury, to Forest Hills, West Roxbury. (See Eng. News, Dec, 16, 1909.) Surface tracks of the Old Colony St. Ry. Co. in West Roxbury and Dorchester were leased. The residents of West Roxbury are now able to continue on to the business district of Boston for a single fare, where before two were collected. An artistic station was erected at Forest Hills, having a capacity of 1,140 cars per hour but used at present by a maximum of 556. The Dudley St. station was remodeled and enlarged to a capacity of 1640 cars per hour. The present traffic requires a maximum of 998 cars per hour maximum. It is claimed that more people use this station daily than use any other steam or electric-railway station in the world. This 2½-mile, double-track extension cost $3,000,000 with equipment and station changes.

While these several large single extensions have been completed some 60 odd additions have been made to the surface lines. When the West End Ry. was leased, in 1897, there were 304½ miles of surface track, the growth of 41 years. In 13 years 156 miles have been added, or about 50%, and at a cost of some $12,000,000. The number of free transfer points has increased, in this time, from 20 to 79, and the number of free-transfer passengers from 23,800,000 to 185,000,000 per year. Besides the 219 elevated-railway cars, 389 additional surface-line cars have been put in service.

In addition, four more important steps in the rapid-transit development of this district are under construction or authorized and approved. In Fig. 2, these proposed extensions are shown with the additions already made. In Figs. 1 and 2, solid lines indicate double track and dotted lines, single track.

The first of these is the East Cambridge double-track elevated extension from the North Station. The Charles River will be crossed on a concrete-arch viaduct now being built beside the Charles River dam, surface cars will climb to the elevated structure by an incline at Lechmere Sq., East Cambridge; at the North Station they will descend into the Tremont St. subway. The cost of this one-mile extension is estimated at $4,300,000.

The second project is the Cambridge Subway and the Beacon Hill Tunnel, commenced in August, 1909. The subway trains of this line will run from Harvard Sq. to and over a viaduct to the Beacon Hill Tunnel and through this to the Park St. station, a new terminal under the present Park St. station. The cost of this line is placed at $12,000,000, equipped, about a ninth of the taxable value of Cambridge.

The third project is known as the Riverbank subway, and, by it, the congestion on Boylston St., Boston, is to be reduced. Boylston St. is parallel to the new line and has a traffic of 56 cars per hour, maximum. The Riverbank subway will have a capacity of 500 cars per hour. It will save ten minutes between Boston and parts of Newton, Brighton, Allston and Brookline, Waltham and Watertown. The city terminal will be at Park St., where the Beacon Hill tunnel ends, and the line passes under the Common to Charles River, thence parallel with the river to Charlesgate. The length will be 1¾ miles and the cost, unequipped, is estimated at $3,000,000.

The fourth and last project is the extension of the double-track elevated line three miles northerly from Sullivan Sq., Charlestown to Malden. The local time from Malden Sq. to Sullivan Sq. will be six minutes instead of 16. The cost will be some $3,500,000.

The present investment as above outlined, including authorized payments on uncompleted projects, amounts to $81,440,400. The cost in 1914, when the projects noted above are all expected to be completed, is placed at $112,633,000. The increase in permanent investment thus will have increased 336% in 16 years and in this period the population, following present tendencies, is expected to show an increase of 43%. The investment will then reach 1/20 the taxable value of property in the districts served. This monopoly will then have unified control and operation of a system covering an area of 125 square miles in 12 towns and cities, comprising surface, elevated and subway lines with free transfers between all.

The Railway Terminal Situation in St. Louis and the Municipal Bridge.*

By EDGAR R. ROMBAUER.†

Problems are made not solely by measures, but also by men, and, therefore, I will outline as briefly as I can to you the human elements that enter into the proposition.

We have, in the lower branch of the Municipal Assembly, 28 men, 23 of whom had never had any experience in legislative work. These men are lawyers, real estate men, retail merchants, saloonkeepers and a barber. They are men who are actuated by high motives, but who have had neither time nor opportunity to study and watch these great problems unless they are presented in an intelligent manner. Then we have, on the outside of our body, the community, composed of a great many interests, and each of those interests, when a question comes before the Municipal Assembly, rushes in, I am sorry to say, not to throw light upon the situation, but, in many instances, to confuse it as much as possible in the interest of the particular interest which is rushing in. These are the human elements that enter into the question.

The problems that have entered into it from the other side since I have been in the Municipal Assembly have been, you might say, three in number. In the first instance, there is that group of problems surrounding the construction of the so-called "Free Bridge," but which I prefer to call the "Municipal Bridge"; second, the problems growing out of the extension of terminal facilities; and, third, the problems growing out of the elimination of grades. These problems have, from time to time, shaded into each other.

The First Part of the Bridge Problem.

The question with which the local administration found itself confronted was that immediately upon taking office the Mayor and members of the Municipal Assembly were informed by the President of the Board of Public Improvements and the Engineer of the city, elected by the people for the purpose, that the money which had been voted by the people for the construction of the Municipal Bridge—$3,500,000—was inadequate for the purpose, and that if the administration desired to complete the Municipal Bridge some way must be found to provide additional funds.

I wish to say that I have frequently heard it said, both by the newspapers and by irresponsible citizens, that the President of the Board of Public Improvements is mistaken in this, and that the money that is provided by the bond issue is sufficient for the purpose. But I desire to say to you that, being a lawyer, and the Mayor being an insurance man, and others of us not being engineers, we thought that it was our duty to take the advice of the President of the Board and not that of outsiders with reference to questions of that character.

The first problem, then, was what should be done with reference to the bridge funds under these circumstances. Some of us in the administration took the view that, under those circumstances, it would be wise and proper to go immediately to the people with a statement of the situation and say to them: "You directed us to build a bridge, but you don't give us money enough, and if you want us to continue to work on the bridge and finish it, and make it a complete whole, you have got to give us more money to do it with." This counsel did not prevail, for the reason that at that time there were many men in the administration who took the view that it would be better to negotiate with the railroads in the hope that, as a result of such negotiations, some way might be found in which the railroads would contribute to the construction of the bridge.

The Mayor thereupon appointed a committee of three, of both branches of the Municipal Assembly, of which the late Francis A. Drew was the chairman, and after some months of negotiations with the railroads the committee reported to the Mayor and his cabinet, so to speak—the heads of departments who consulted with the Mayor—that the situation, as far as the railroads and the Municipal Bridge was concerned, was this:

None of the larger railroads entering the City of St. Louis would commit themselves at that time to the use of the bridge, when completed. Most of them said they might use it, but they wanted to know where the approaches were going to be, east and west, and what the city was going to charge for the use of the bridge and what terminal facilities the city could give the railroads if they desired to use the Municipal Bridge.

While these negotiations were going on negotiations were begun with the officers of the Terminal Railroad Association, looking to the extension of terminal facilities.

The Terminal Question.

This is an old controversy in the City of St. Louis. It began almost a generation ago, and it went through the stage of the building of the Merchants' Bridge, the absorption of the bridge by the Terminal Railroad Association, and Mayor Wells' administration was called on to deal with it, and dealt with it in this wise:

During the administration of Mayor Wells there was created by ordinance a body to be known as the "Municipal Bridge Terminal Commission," which body was to represent the city in its negotiations with the railroads and arrive at some plan looking to a solution of the terminal question.

At the time the Municipal Bridge and Terminal Commission began its negotiations with the railroads there was prevalent a charge called by the railroads a "differential," and by the other interests in the city an "arbitrary," which charge was a terminal charge and added to all freight shipments coming no matter from what distance, being added on at East St. Louis.

As a result of the negotiations between the railroads and the Municipal Bridge and Terminal Commission, the railroads abolished that charge on all freight coming from distances a certain distance from the city of St. Louis, and popularly known as the "hundred-mile limit."

The Municipal Bridge and Terminal Commission thereupon recommended to the Assembly the passage of a bill which was introduced and subsequently became known as "Council Bill 267." On August 28, 1908, they recommended to the Municipal Assembly that this bill be passed. It was also advocated in writing by various municipal exchanges and business men's associations.

The bill provided roughly the facilities which would permit the railroads to broaden their tracks on the so-called "Rankin tract."

The Rankin tract had been leased by the railroads.

When I first knew the Rankin tract—which extends from Manchester Ave. on the south to the railroad tracks on the north, and from Compton Ave. on the east westwardly for quite a distance—it was a vacant lot on which circuses were held, and later on was used in part as a baseball park. When the Rankins owned that property they or their predecessors in title figured that some day that tract would become a residence section, and they platted on that tract paper streets, and filed that plat in the City Hall, dedicating those streets for public use. Since that time no actual street has ever existed on the Rankin tract; the streets themselves now are paper streets; Rankin tract is now surrounded by a fence and used as a cow pasture.

That being the situation, it was provided in Council Bill No. 267 that these paper streets should be vacated and that the railroads should have the right to cross with their tracks Ewing and Compton Aves., and in return, that they were to build a subway at either Compton or Ewing Ave., at a cost of about $400,000.

The bill did not pass. It never got any further than a favorable report, with amendments, by a majority of the Railroad Committee in the Council, and shortly after that report was made the Municipal Bridge and Terminal Commission and Mayor Wells said that the amendments that the Railroad Committee offered were not in the interests of the city, and that the Council ought to pass the original bill; the Council recommitted the bill to the Committee, and shortly afterward the Council went out of existence.

This was the situation in which Mayor Kreisman and his administration found the terminal troubles when they took office.

The Mayor asked for a conference, to which were invited all the members of both branches of the Municipal Assembly, the members of the Municipal Bridge and Terminal Commission, the President of the Board of Public Improvements and the City Councils of the City of St. Louis, as well as officials of the Terminal Railroad Association.

Officials Confer With the Railways.

These conferences began and lasted for a number of months. There were a number of questions discussed in these conferences. I may say that one of the very first questions that was raised in these conferences was the question of rates.

Certain men in those conferences took the view that the rates charged by the Terminal Association were unfair and discriminated against the citizens of the city of St. Louis, and when the question arose, Mr. McChesney, who was chairman of the railroad men in those conferences, took the floor and said, in substance, this:

"Gentlemen, I will not discuss with you the question of rates. The question of rates has no connection with the question of facilities, and these questions should not be discussed at the same time. I do not want to be arbitrary, but I want to say to you that I believe our rates are fair, and I won't discuss them. I want to say to you that the reason I won't discuss them is because the Municipal Assembly is not the proper party with which to discuss the question of rates."

As I understood his position then, and as I understand it now, it was this:

The railroads are required to deal on the question of rates with the United States, through the Interstate Commerce Commission, on interstate rates, and they are required to deal with the State Commissions on State rates, and, if I understand his temper correctly, it was that they did not propose to begin to discuss with every city in the United States the local rate question.

He stated at that time positively, in the very first conference that was held on the subject, that if the question of rates was going to be injected into the question of facilities, then every man in the conference might just as well go home and attend to his business, because they did not intend to put any bill in in which the question of rates was to be considered, and that we could avoid a good deal of friction and a great deal of feeling by simply saying then and there that we insisted on the inclusion of the question of rates, and the conference might terminate.

Notwithstanding this statement by Mr. McChesney, the conferences went on, and the various questions at issue between the city and the association were threshed out until a situation arose in those conferences where every man in the conference was unanimous on the proposition that the terms offered by the railroads were fair, if the question of rates was eliminated from the discussion.

Now, the terms thus agreed to in those conferences were that the Terminal Railroad Association was to pay the city of St. Louis in cash, and before the bills should become operative, $1,000,000, and that they should, in addition, construct at their own cost and expense a viaduct, which I understand is estimated to cost about $400,000, at Compton Ave., and a viaduct to cost approximately the same, about at Ewing Ave., a viaduct at Union Ave., and a viaduct at Kingshighway, on their Belt Line. They were, in addition, under the terms of the bill, to build a passenger station in North St. Louis at an expense of $50,000, and the bill contained a provision which, in my opinion, was the most important provision of the entire bill, and which provided that if, in the future, any road came over the Municipal Bridge, it was to have the right to use the entire trackage facilities of the Terminal Railroad Association upon fair terms, to be agreed upon between such railroad and the Terminal Railroad Association; and in the event of their failing to agree, then upon such terms as might be adjudged to be fair by any court of competent jurisdiction.

When the thing got into that shape, the question of rates was again presented, and some of the men in the conference said they wanted to talk over the matter of rates. The Mayor of the city of St. Louis and all the members of the Conference Committee on the part of the House of Delegates, and the President of the Board of Public Improvements were in favor of dealing with the railroads on the basis presented and settling the question of rates at some time in the future. But the three conferees on the part of the City Council would not agree to that, and the conference then broke up, with the un-

*Abstract of an address on "Our Present Municipal Railroad Problem," delivered before the St. Louis Railway Club, Nov. 11, 1910.

†Speaker of the House of Delegates, City of St. Louis.

derstanding that those of us who represented the House in the conference were to go on and consult with the members of the House and those who represented the Council were to go and consult with their fellow representatives in the Council.

The next morning, when I picked up a newspaper, I found that the result of the consultation that had gone on in the Council was a declaration that passed unanimously in the Council that if the railroads would not wipe out what they called all the discriminatory rates, they did not care to discuss the matter any further. And that placed the Mayor and those men who sided with him in those conferences in this position:

That we were either bound to do nothing or were bound to show our hands. We said: "We will lay the cards right out on the table; we will present the bill as far as it is agreed to in the conference, and we will explain the matter to the people of St. Louis, and then they will understand our position, and the issue will be clean-cut." And we did lay the cards on the table, and just about that time hell broke loose in this town.

Now, why? Is this a community such that a body of intelligent and honorable, clean-minded men cannot discuss a public proposition without being blackguarded? Is it necessary in this city, and has it come to this, that when my wife comes down to breakfast and picks up her mail she has to have insulting postal cards showing me holding a bag of money labeled "Terminal Railroad Association," and the city of St. Louis kicking me behind, in order that a public question can be intelligently discussed?

Every man that stood up in the House of Delegates and said that he was in favor of the proposition was put down and publicly denounced as being in favor of all those rates, and every newspaper that was making that assertion knew that the man had nothing to say about the rates! Why, there was an opinion on file by the City Counsellor saying that the Assembly could not take affirmative action on the question of rates, even if it wanted to, and the only thing that was up to us to do was to say: "We will take this million dollars in cash, and this one million two hundred and fifty thousand dollars in public improvements, and we will have the facilities; or, we won't take it." And the gentlemen in the Council said: "It is a bluff; it is all a bluff. If we have a show-down, they will come across."

The bills failed, as you all know. But you do not know how they failed. You do not know that there were men in the House of Delegates that voted against their honest convictions; but they did, when they voted against those bills. You don't know that there were men in the House of Delegates that were threatened the loss of their business, and they could not stand it, if they voted in favor of those bills. Why, there was a man that stood up in the House of Delegates and said: "The Nineteenth Ward votes no," because, as he said to me, "My own brother came to me and said, 'Billy, have you got to be a thief?'" That is the way that campaign was carried on; they have hounded us like low criminals. Most of them that stood up and were counted on those bills had such a fire directed at them, and they were hounded in such a way, that they were afraid further to stand up for their own convictions and be counted, although they felt then and feel now that the bills were in the interest of the city of St. Louis.

Shippers Try a Conference.

What was the next step in this proceeding? Certain gentlemen in this community who had helped to defeat these bills said: "We will tell you; the whole trouble with you fellows was that you did not know how to deal with the railroads. If you will turn this matter over to us we will show you how to deal with the railroads. You appoint a committee of each branch of the Municipal Assembly to cooperate with us, and we will form a 'shippers' committee,' and we will have the railroads down on their knees in less than no time."

So we did that.

The House of Delegates passed a resolution which provided that I should appoint that committee—and I did it. I gave them the very strongest anti-Terminal men in the House. I put Mr. Hilkerbaumer, who was the author of what the papers chose to call "the famous Hilkerbaumer Resolution," at the head of it. I put on it Eilers, who got up the night the bill was up in the House and said it was a sin to rush a thing of this sort through the Assembly, although he had never attended a single session of the conferences when the negotiations were going on for months—I put him also on the committee. I put Chapman on the committee, and I said to him, "Ollie, I will put you on that committee, and you are the only man in the whole bunch that I am sorry for."

You know that the Shippers' Committee met, and you know that they had a long argument with the railroads, and you will know in a day or two that they are going to disband, and the situation is going to be just where it was before they organized. The only thing I have ever heard from any one of them has been what Mr. Teichmann told me: "Well, we presented such an argument to them that they ought to have changed their conduct, but they did not see fit to do it."

More Money for the Bridge.

Let us get back to the bridge. In the meantime the million dollars that we had hoped to put in on the bridge went a-glimmering, and then the proposition arose, "How are we going to get the money for the bridge?" The Mayor and his friends in the administration introduced in the House of Delegates, with the approval of the President of the Board of Public Improvements, a bill which provided that there should be submitted to the people a proposition to issue $2,500,000 additional bonds. That bill received the unanimous approval of every member of the House of Delegates voting on the proposition, Republicans and Democrats, and went to the Council, where it is now reposing in committee, having been there now about four or five months. I understand the position of the gentlemen in the Council with reference to that bill to be that, while they believe the money ought to be voted to complete the bridge, they do not believe the people have good sense enough to see it that way and will vote it down; and, therefore, they are not going to give them a chance to vote on it at all. That is the only explanation I have ever heard in regard to that bill.

The President of the Board of Public Improvements tells us that some time early next year the channel piers and the superstructure are going to be on that bridge, and that, unless we provide money to build the approaches, you will need to go to the other side of the channel in airships.

The only other way offered for a solution of the question at this time is through what is know as the "Busch Bill," which is now pending in the City Council.

The Busch bill, roughly speaking, provides that the Manufacturers' Railway will build the approaches and own them as part of its right-of-way, and that the city may have the option to buy, under certain conditions. I will say that I believe the bill in its present form is unsatisfactory to all the men in the administration, both in the House and in the Council, and I do not believe—without speaking by authority, but from my general knowledge of the situation—I do not believe the bill has a ghost of a chance to pass in its present form, because not only is there an aversion to any part of the bridge belonging to anyone but the city itself, but the City Counsellor has informally stated that in the present form there are so many legal complications about the bill that, in his judgment, it would be an unwise proposition in its present form.

Grade-Crossing Elimination.

When we got into office we found that one grade-crossing bill had been passed, and it was for the crossing at Tower Grove Ave. It provides that the railroads shall depress their tracks 22 ft., and is being bitterly contested by the railroads, because they say that is going to destroy the industries along their right-of-way. The case is now in the courts—in the Circuit Court—and has been decided in favor of the city. From my general knowledge, as a lawyer, of those cases, I take it for granted that there will be an appeal to the Supreme Court of the State of Missouri, and then the United States Supreme Court, and then, probably, as in the United Railways case, when it comes back again to the Circuit Court, it will again be appealed to the Supreme Court of the United States, so that, in the course of things, the case will probably be decided in ten or twelve years.

When we got in there we adopted a different plan. We sent for the Board of Public Improvements; we asked them to prepare for us detailed plans and specifications for the elimination of all grade crossings in the city of St. Louis, and the Board of Public Improvements has done this. These plans, I understand, have been prepared for every grade crossing at a traveled point in the city of St. Louis, and we have begun to take the question up with the railroads.

The board also collected for us a lot of statistics, showing how the matter had been handled in other cities; this showed that in some of the cities the city paid about 25%, the State paid about 25%, and the railroads paid 50%; in others it was divided, 65% being paid by the railroads, and 35% by the city. In Chicago, I understand, the railroads bore all the expense, except the so-called "consequential damages," and that is a rule that the administration thought was a proper one, public sentiment considered, to establish in the city of St. Louis.

And so we took it up with the railroads on that basis. I am glad to say that the railroads seem about to meet us in a fair and liberal spirit with relation to that matter.

We have already agreed with the railroads affected for the abolition of grades on Compton Ave, which, under the bill passed and accepted by the railroads, are to be covered by a concrete structure. I understand that plans have been agreed to and the contracts will be shortly let, and the bill provides that the structure is to be completed in July of next year.. The structure, as I understand, is estimated to cost about $400,000, and, outside of some expenses which the city would have to go to, anyway, on account of a sewer in Chouteau Ave., in the way of changing grade, the structure will cost the city about $2,000. The bill provides that the railroads shall thereafter maintain in repair this structure.

We are about to take up the question with the railroads of the Poplar St. track, and we have taken it up with them on Chouteau Ave. and the Vandeventer track and the solution of the question at Chouteau and Vandeventer would have been reached but for the fact that the industries affected out there complained so bitterly of the arrangement that the city was about to make with the railroads that we have been trying to find some way to modify the plan in their interest, and we have been at it about six months, trying to do that, but find we can not do it; we will probably have to proceed on the original plan.

But, as I understand the situation, if we follow out the plan to its logical conclusion, which the railroads seem disposed to follow out, we will, in the course of time, peaceably and speedily eliminate all the grade crossings in the city of St. Louis at comparatively small cost to the city.

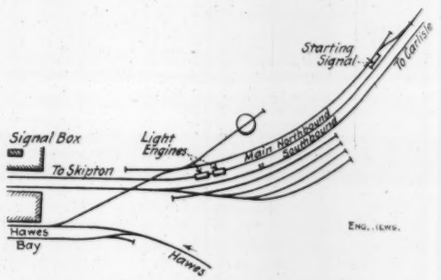
A Disastrous Collision on the Midland Railway of England.

By H. RAYNAR WILSON.*

On Dec. 24, 1910, a serious accident occurred on the Midland Railway of England, the cause of which cannot but interest the readers of Engineering News.

The scene of the disaster was at Aisgill Moor on the Midland's main line to Scotland, about 50 miles south of Carlisle. In the immediate vicinity is the highest altitude reached by a railway in England and Aisgill is the second highest point. Most of the express passenger trains have assisting locomotives in front which are detached at Aisgill or Hawes Junction, one mile further south. These assisting locomotives are turned for the return trip on an engine turntable at Hawes Junction.

On the night of the accident there were, owing to additional trains for the Christmas traffic, no less than nine of these assisting locomotives waiting to be turned at Hawes Junction. Two of them which had to return north to Carlisle had already been reversed; but sundry express and excursion trains, going north, prevented the two locomotives getting away. They were, however, in the way of the other seven, so the towerman placed them for a few moments on the northbound main track. Unfortunately, he forgot them whilst in that position and when asked on the block-instrument whether the track was



Plan of Tracks and Position of North Bound Starting Signal at Hawes Junction, England, on the Midland Ry.

clear for the Scotch express from London he indicated that it was, gave the necessary permission for it to approach and lowered his signals. Included among the latter was the down starting signal and, as the two locomotives stood on the northbound track between the tower and the signal the drivers of the locomotives supposed when the signal was lowered that the section was clear for them to return to Carlisle. They took the signal as theirs and started but were overtaken by the express within a mile.

The two light locomotives and the two locomotives of the express train and six of its eight cars were derailed. Fire broke out in the debris of the collision and at least thirteen passengers were killed or burned to death. There were no fatalities, however, among the crews of the four locomotives which bore the brunt of the collision.

It will occur to most American readers that the train dispatcher might be at fault and that track-circuits or manual control should have prevented the mistake. Some information on these

*47 Victoria St., London, S. W., Author of "Mechanical Railway Signalling" and "Power Railway Signalling" (reviewed in Engineering News of Sept. 16, 1909).

points and a few observations as to the fire may therefore be of interest.

Train-dispatching is not in use on British railways. The towermen are advised by telegraph how trains are running and they regulate the movements of other trains. The trainmasters at large depots and junctions exercise their discretion as to connecting trains. The writer has, however, frequently urged the adoption in Great Britain of train-dispatching for the purpose of getting freight trains over the road more rapidly, and this has been done on one section of the Midland Railway and one section of the Great Western Railway.

Before dealing with the signaling, it should be noted that the accident would not have occurred had the men on the light locomotives obeyed the rules. They stood on the main track for 21 minutes and ought, therefore, in accordance with rule 55 of the standard regulations used by all British railways to have whistled to remind the towermen. If that reminder had not been immediately effectual, the fireman ought to have gone to the tower and remained there until the locomotives could be given a clear track to proceed.

Nor would there have been an accident had the signalman obeyed clause 13 of his block system regulations. To appreciate this point it must be understood that the block-instruments in the signal tower on English railways give visual signals as to the state of the section by means, generally, of a needle which is deflected to the left or right by the movement of the handle of a corresponding instrument in the tower in advance. As Clause 13 referred to is known as the blocking-back rule and lays down that before the main track is obstructed by a train or locomotive admitted on to it from another track, the handle of the instrument must be turned to cause "train-on-line," to be indicated on the instrument of the tower in the rear. Had the towerman done this before moving the light locomotives onto the main track, the Scotch express would have been warned at the previous block signal.

Track-circuits are the exception and not the rule in England; but they are being adopted more generally year by year. Until 1900 there were only two or, at the most, three track-circuit sections in use here. Comparatively few British railway men know anything about them and most of the Telegraph Superintendents, to whom officials looked for advice and guidance, were of the old school and knew little more. The latter, having been convinced by a demonstration that a locomotive standing on a well-sanded rail did not lock the signal, forthwith unanimously rejected track-circuits as unreliable. These conclusions will appear absurd to American signal engineers, but they prevailed until 1900. In that year some British officers went to America on a tour of inspection and these visits led to automatic signals being introduced on the London & South Western Railway. The writer's visit to America in 1901 resulted in an installation on the North Eastern Railway. Progress dates from this time and most of the underground lines are now equipped with track-circuits, while many of the larger companies have one or more lengths of track-circuits. Except, however, in the few installations of automatic signals, they are always used for locking the manually operated signals controlling a length of line of which the towerman has an indifferent view. It will therefore be seen that there was nothing unusual in there being no track-circuits at Hawes Junction.

Manual-control "lock and block" is also the exception and not the rule. The Midland, along with other large British railway companies, has not adopted it except in a few isolated special situations. It is found that absolute block-working must be modified for freight trains to the extent that while a second train is not allowed to leave the tower in the rear, say A, until the preceding train has passed the home signal of the next tower, say B, the first train need not necessarily have gone so far forward on its journey into the next section—towards, say C—as is required for passenger train working. Freight trains may also leave A while switching is being done at B. For these reasons manual control, while excellent for suburban traffic, hinders the movement of freight trains and so is objected to by all the large British railways. But even if it had been installed at Hawes Junction it is questionable whether the accident would have been avoided, as the placing of the light locomotives on the northbound track was one of many switching movements, some of which would undoubtedly have led to the electrical lock on the home signal lever being taken off.

Coming now to the subsequent fire. All the cars, but the two sleepers, were illuminated by gas. The latter two were electrically lighted. It is not known whether the outbreak originated from live coal, thrown from the fire-boxes when the collision occurred, coming in contact with the woodwork or whether escaping gas became ignited. In this connection the writer would observe that up to about two years ago electricity was rapidly replacing gas as an illuminant in railway cars. Then came the small inverted incandescent mantle with an anti-vibratory suspender. This not only gives a better light than electricity but is steadier. But of most importance to railway companies, its introduction saved them the further expense of installing the electric light and scrapping their gas fittings, gas-producing plant, etc.

Steel cars are not used in England at all except on the underground railways, and as such disasters as that at Hawes Junction are infrequent, it is unlikely that they will be introduced generally.

A Heavy Concrete Bridge Built to Resist Ice Pressure.

By MASON D. PRATT,* M. Am. Soc. C. E.

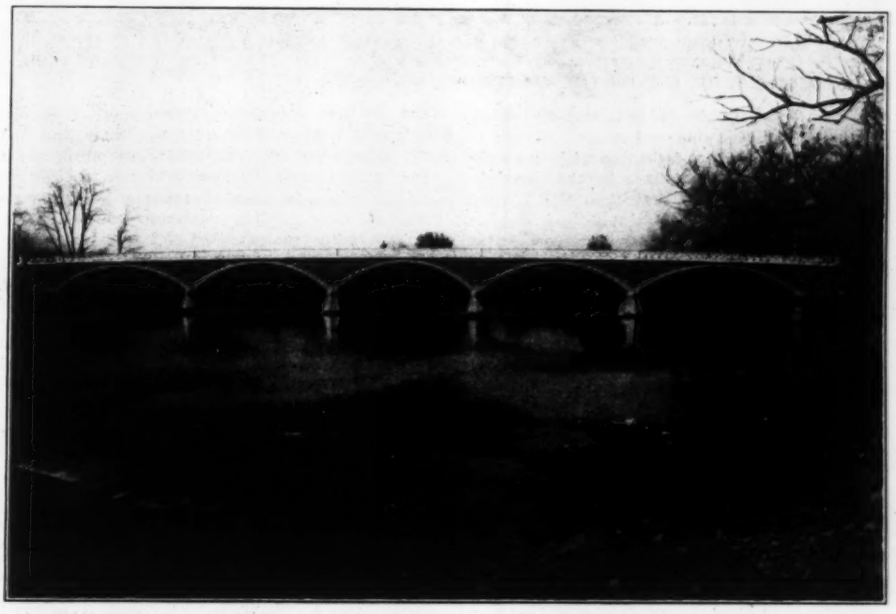
A five-span non-reinforced concrete arch highway bridge recently constructed over Swatara Creek near Hummelstown, Dauphin Co., Pa., while involving no exceptional features may be interesting from the fact that it contains some departures from the usual practice for such bridges.

In 1895 the State Legislature passed an act authorizing the reconstruction of county bridges at the expense of the State where such bridges had been destroyed or damaged by floods and under this Act several million dollars have been expended.

The bridge which occupied the site of the one here described was a light three-span truss bridge of Phoenix column construction, which was carried off by an exceptional flood accompanied by ice in January, 1910, and the viewers in this case recommended that the bridge be replaced with a concrete structure, estimating the cost at $18,500. After the usual court formalities and the authorization of construction, the Board of Public Grounds and Buildings of the Commonwealth appointed the writer to act as Engineer to superintend its construction.

The bridge is located about 300 ft. below a mill dam having a pond of considerable extent and as ice conditions similar to those that caused the failure of the first bridge are apt to occur again it was thought best to give the bridge structure considerable weight. For this reason the spans were made comparatively short and plain concrete was used in the arches. Each span is 53 ft. in the clear, with a full width arch ring 18-ins. thick, at the crown, and 3 ft. thick at the spring. The exposed face of the arches was reduced to 12 ins. at the crown and 18 ins. at the spring. The spandrel walls were run up in alternate courses of dressed and rock-faced brownstone masonry from the famous Hummelstown quarries in this vicinity, in courses parallel to the arc of the roadway grade and contrasting in color with the usual gray concrete tone of the arch rings and piers. The spandreis were filled with a lean gravel concrete and the roadway paved with brick with tar filled joints. The use of concrete in the spandrel filling is a departure from the usual practice but was in line with the idea of making a solid heavy substantial structure to resist the impact of ice. It has the further advantage that the paved roadway will maintain an even surface, which is not always the case with earth filling of varying depth. Large one-man stone were embedded in all concrete.

The appearance of the bridge is further enhanced by the concrete railing, the balustrade of which is of ornamental design. The concrete for this railing was cast in 5 ft. sections in sand molds. The cap is of cut brownstone of oval form and grooved on its under side so that it could be bedded to the balustrade with cement grout and doweled.



SWATARA CREEK BRIDGE, HUMMELSTOWN, PA.

(A Concrete Arch Bridge with Concrete Filling and Spandrel Walls of Hummelstown Brownstone.)

The bridge is 310 ft. long over all, 21 ft. 6 ins. out to out, with 17 ft. roadway between curbs and no sidewalks. The roadway grade in on a circular arc having 2½ ft. rise at its center. The total cost of the bridge exclusive of engineering supervision and the usual legal expenses incident to municipal and state work was $18,775, and it is the only concrete bridge built by the State under the 1895 Act. The contractor was the Ferro-Concrete Co. of Harrisburg.

*Consulting Engineer, 16 S. Market Sq., Harrisburg, Pa.

The Cumberland-Connellsville Extension of the Western Maryland Ry.

The Western Maryland Ry. has now under construction about 87 miles of new line connecting Cumberland, Md., with Connellsville, Pa., which, with the eastern connections to tidewater at Baltimore, Md., and western connections to the lake ports of the New York Central Lines, will make a new trans-Allegheny railway from the Great Lakes to the Atlantic of exceptionally desirable line and grade.

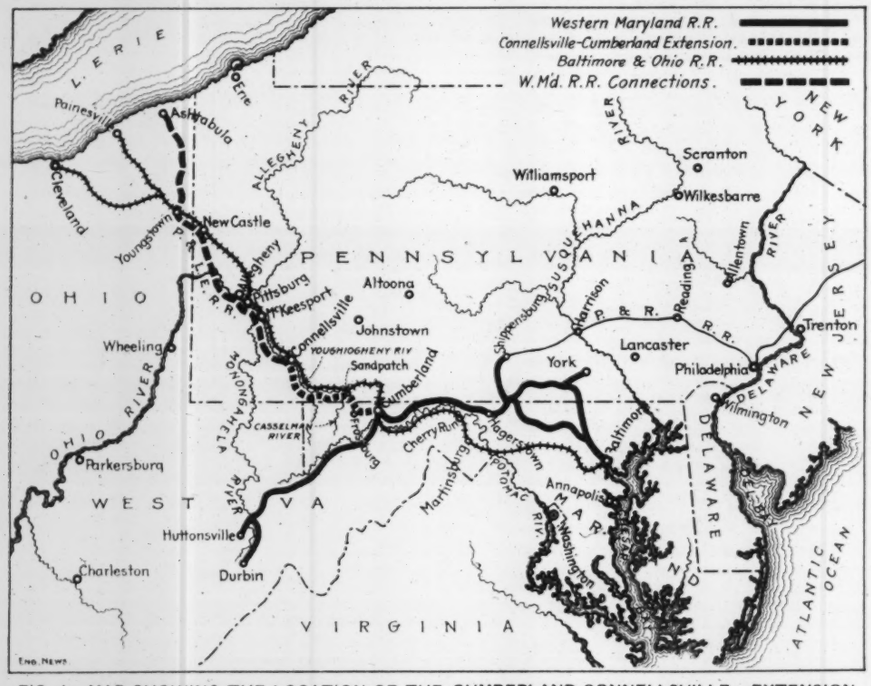


FIG. 1. MAP SHOWING THE LOCATION OF THE CUMBERLAND-CONNELLSVILLE EXTENSION OF THE WESTERN MARYLAND RY. IN RELATION TO THE REST OF THE WESTERN MARYLAND RY. AND OF THE BALTIMORE AND OHIO R. R.

This new development is in line with the policy of the road since its purchase by the Gould interests in 1902. Up to that time the Western Maryland Ry. was a local single-track road of some 258 miles of track extending from an inland station at Baltimore, Md., to Cherry Run, W. Va., a town on the Potomac River, about half-way between Harpers Ferry and Cumberland, with side line connections to York, Pa., and to Shippensburg, Pa., at which places it connected with the Reading system. Immediately after the purchase of the road in 1902, a number of steps were taken to increase its size and usefulness. These included the construction of a six-mile extension to a tidewater terminal at Port Covington, at the southern part of Baltimore harbor, opened in 1904; the purchase, in 1905, of the line of the West Virginia Central and Pittsburgh Ry. Co. running from Durbin, Huttonsville and other points in West Virginia to Cumberland, Md.; and the construction in 1906 of the 61-mile extension from Cherry Run to Cumberland, joining together the eastern and western sections of the road. Along with these extensions, the entire line was improved by laying heavier rails, straightening curves, replacing structures and adding second tracks outside the cities of Baltimore and Cumberland.

The next step in the improvement was the Cumberland-Connellsville extension, commenced in June, 1910, and now under construction, with every prospect of being opened for travel in the Fall of the present year. When this is completed the road will have 630 miles of main line track. This new extension consists of a line between Cumberland, Md., and Connellsville, Pa., there to connect, under a traffic agreement, with the line of the Pittsburgh & Lake Erie R. R. a New York Central subsidiary road, which runs from Connellsville through Pittsburgh to Youngstown, connecting there with all the lake ports of the New York Central Lines. Under this arrangement it will be seen that the Western Maryland R. R. gains an entrance into the Pittsburgh and Lakes district and the New York Central Lines a much easier route from Pittsburgh to New York City than they now have over their main lines through New York State.

The new extension is 87 miles long, and is estimated to cost $12,700,000. All structures except the long tunnel near the summit level are designed to carry in future a two-track line, but at present only about 22 miles west of Cumberland will be double-tracked. The main effort in the location has been to provide a low grade line, and as a result a maximum grade of 42 ft. to the mile, compensated for curvature, has been achieved against east-bound traffic, by far the heavier direction of freight movement. The maximum grade against west-bound traffic is about 92 ft. to the mile.

With the exception of the first few miles out of Cumberland, the extension is built entirely upon new right-of-way. For this short distance the line of the Georgia Creek and Cumberland R. R. has been purchased and is being utilized, with improvements, for the two-track line of the extension. Leaving Cumberland, then, the road follows the aforementioned line through the narrow defile called "The Narrows," through which all roads west of Cumberland must pass, and starts immediately to climb the mountains. Instead of turning to the north into Pennsylvania, as does the Baltimore and Ohio R. R. (see accompanying map), it swings west along the minor water-courses into Maryland, through Frostburg, a town of some 8,000 inhabitants, and passes over the line of the B. & O. again at Sand Patch, at an elevation of 75 ft., having in that distance gained some four miles in length of line over the older road. It reaches the summit elevation about 20 miles west of Cumberland at Big Savage Mountain, which it pierces with a tunnel 3,300 ft. long at an elevation of 2,340 ft. above sea level. Up to this point the extension is double-tracked

From Sand Patch to Connellsville, the line ascends on the easy grade noted above, practically paralleling for the entire distance the line of the Baltimore and Ohio R. R., and following the course of the Casselman and then the Youghiogheny Rivers. Mainly on account of the better location between Cumberland and Sand Patch, the grades of the Western Maryland extension are much lower than those of the competing B. & O. R. R.

There are no curves sharper than 8° on the line, and all those above 2° are eased by transition curves. Compensation of grade for curvature is provided at the rate of 0.04% per degree of curve. There are four tunnels on the line, three for two tracks, 840, 850 and 900 ft. in length, respectively, and one for single track 3,300 ft. in length. These tunnels are all being driven through the sand-clays, shales and coal measures peculiar to the coal country, and are to be lined throughout with concrete. Extra clearance is provided for both sizes of tunnels, that for single track being 17 ft. wide and 22 ft. high in the clear, and those for two tracks 30 ft. wide and 22 ft. high.

All bridges are to be of steel with concrete piers and the culverts are of concrete. The bridges are designed for one of the heaviest loadings ever used, a 2-8-8-2 Mallet engine with 55,000 lbs. on each of the eight drivers and 38,000 lbs. on each of the four tender axles followed by 5,500 lbs. per lin. ft. of train load (Fig. 2). This is somewhat heavier than Cooper's E-60 specification. There are a number of long viaducts, some of which are on high pedestal piers of concrete instead of the usual steel tower bents. In all some 14,000 lbs. of steel will be required, and about 150,000 cu. yds. of concrete.

As would be expected through such mountainous country, there is a great deal of heavy cutting. In the total 87 miles there are 8,000,000 cu. yds. of excavation, and one cut, the largest on the line, is 1,300 ft. long, 100 ft. deep and contains about 217,000 cu. yds. of material. Practically all of this excavation is being made with steam shovels.

Mr. B. F. Bush, President of the Western Maryland Ry., and Mr. Alexander Robertson, Vice-President and General Manager, have superintended the construction of this extension, and the engineering work of location and construction is under the direction of Mr. H. R. Pratt, Chief Engineer of the Railroad, with Mr. Gilbert H. Friend as Principal Assistant Engineer in Charge of Construction. The contract has been let in two parts to two organizations, of each of which, Mr. John B. Carter, of Chicago, is the head, the Carter Construction Co. and the John B. Carter Construction Co. Much of the heavy grading work is being done by subcontract. The design of the structural part of the bridge work is under the charge of Mr. A. W. Buel, of New York City, and is being fabricated and erected by the McClintic-Marshall Construction Co., of Pittsburgh.

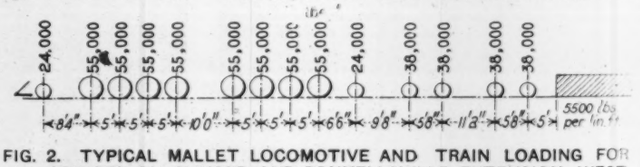


FIG. 2. TYPICAL MALLET LOCOMOTIVE AND TRAIN LOADING FOR BRIDGES ON CUMBERLAND-CONNELLSVILLE EXTENSION, WESTERN MARYLAND RY.

A RIDING HALL FLOOR, recently laid in the arena of the new club house of the Riding Club of Washington, at Washington, D. C., has a construction the details of which may be of value to anyone about to construct such a floor. The arena is on the main floor of the building, and is carried over the basement on a concrete slab. Upon this slab was first laid a thin coating of asphalt, then a layer of small boulders close together and embedded in hot asphalt and then another coat of asphalt to cover completely the boulder layer. Upon this solid base was placed a 6-in. layer of packed clay and finally an 8-in. layer of tanbark, which latter makes the finish coat.

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We take pleasure in being able to present with unusually full detail a description of the design of the new Ohio River bridge of the Pittsburgh & Lake Erie R. R. Co. The structure is so interesting as to commend it to the study of all who have to do with bridge construction. It happens that many already know this bridge, as it was completed last summer and has been in service since then. But the first published article concerning it appears in the current January "Proceedings of the American Society of Civil Engineers," from the pen of Mr. A. R. Raymer, Assistant Chief Engineer of the company. Through the courteous assistance of all connected with the bridge we are enabled to give a description of the design in this issue.

The innovations which strike the eye first, in examining the design, are the roller bearing of the tower post and the wedge bearing at the anchorage. But whatever merit may lie in these, we believe equal importance must be credited to the solidity of construction represented by the chord and tower sections and most of all by the 100% splices of the chords. Concerning the well-stiffened section of the chords nothing need be said, since the Quebec Bridge case exhibited the weakness of inadequate lateral strength. But reliance on faced joints, with mere stay-plates as splices, is so common that it is often considered quite unobjectionable; and in maximum sections, as the heavy chords of large cantilever bridges, the difficulties of detailing have always been a persuasive temptation to tacit acceptance of light splicing as unavoidable. The courageous departure from precedent in this case, and the admirable solution of the problem of producing workable full-section splices, are alike gratifying.

That the Beaver Bridge is very heavy appeals to us as commendable rather than the reverse. The ideal of lightness in bridge construction has in the past been influential and valuable; but the indications are that every bridge removed after short life has been removed because it was too light, that is to say too weak: Though strong enough for its service when built, it was outgrown very soon, and had it been designed heavier it would have enjoyed a longer life. Of course we do not hold for "padding," mere increase of weight regardless of strength; the extra metal must be used judiciously. The point is that a design materially heavier than the strict minimum ought to show ultimate economy, in nearly every case.

On another page of this issue we publish the report of the Commission appointed to investigate the recent collapse of the Henke reinforced-concrete building in Cleveland and, in our correspondence column, a letter written concerning that failure a full month before the issuance of the report. The letter, it will be noted, guarantees to its author a certain gift of prophecy for at least a part of its predictions regarding the probable cast of the report are borne out by the report itself. Without in any way disparaging this prophetic judgment, however, we would remark that a careful reading of similar reports in the past would make it a safe bet, on the principles of chance, to record just the same predictions as did Mr. Godfrey. No concrete building failure has escaped the indictment of lax inspection, resulting in poor concrete and too early form removal. Some of the failures have had faint criticisms of design, but in the majority of cases the inference, at least, has been that given the designer's blue prints a competent constructor would have completed a building that would not have failed.

Such conclusions have a valid basis of fact. The very best and safest of designs may be ruined by careless construction, whereas competent, thorough construction may often correct all but the fundamental errors of design. Obviously, then, the first duty of the investigator of a failure is the inspection of the construction, and if that is found defective one cause of the collapse is discovered. Unfortunately, this one cause is generally considered sufficient and the investigation of the design never gets beyond a perfunctory stage. The profession is never informed whether the building would have probably stood up if its construction had been of the best. The one lesson that is needed from the study of concrete building failures is lost. We know that a structure poorly built will fall down; *that* does not need the confirmation of another failure. What we want to learn from failures is the extent to which the design is responsible, so that the debatable questions of design, which can never be fully settled by observation of a standing structure, may be lighted up.

In the Henke Building investigation the personnel of the board of inquiry was superior to the usual board delegated for such work. Instead of a coroner's jury entirely ignorant, we are tempted to say, of everything, or an appointed lay body guided by technical advice, or a building department, hedged about by personal and political prejudice, we have a board of competent architects, builders and engineers. It is very possible that this board made a thorough study of the design of the building, in which case their report that the "reinforced-concrete design was a safe one" is final and it would be a supererogation on the part of any one not intimately acquainted with that design to question the verdict; but, in view of the very decided evidence of errors of construction and the extended reference to those mistakes in the report, we are inclined to believe that, as is usual in such inquiries, the study of the design was not so thorough as to warrant its complete exoneration from blame. We would not go so far as our correspondent, Mr. Godfrey, and blame the failure on the design of the columns, but on the contrary, we would not completely whitewash the design. Under certain accepted ideas that design may have been standard, but the establishment of such a standard under all conditions is decidedly objectionable.

The designers of reinforced-concrete structures must recognize one thing; the safety of their design is dependent upon the construction. Concrete construction is not fixed as is that of steel. The design cannot be sent from the drawing table with perfect confidence in its precise reproduction in the structure. It is the joint product of the man in the office and the man in the field and any design which fails to recognize this is a poor design, no matter how nearly it may conform to accepted standards. No engineer who is not prepared to supervise the construction of a concrete structure is justified in designing that structure as closely to the safety limit as he is when its construction is to be under his eye. It follows, then, that the engineer must add precautionary details, such for instance as fabricated reinforcement, hooped columns, direct connections of members, etc., in the design of those buildings he does not expect to supervise, even though he considers those details superfluous in well directed work. Even then the constructive details may be so lax as to cause failure, but he has placed all the possible obstacles in the way of such laxity, and no blame can attach to him for a failure.

From the account of the Henke Building collapse we doubt if it could have been saved in the designing room; but the minds of those who did design it might be more satisfied if they had insisted on proper supervision, or lacking the power to accomplish that, had hooped the columns, anchored the beams and made assurance that the reinforcement was correctly placed.

Which makes the biggest profits, the Express companies from their express business or the Pullman Company from its parlor and sleeping cars? The information to make possible an answer to this question is now for the first time available through a report by the Interstate Commerce Commission on statistics of the express business of the United States, made public on Jan. 12.

It appears from this report that in the year ending June 30, 1909, the total profits from the express business as reported to the Commission were $11,387,489. The Pullman Co. in the previous year, according to the "Manual of Statistics," made net earnings of $14,742,524. These earnings, however, included profits on $24,000,000 worth of cars manufactured as well as on the sleeping and parlor cars operated.

In order to earn this eleven and a third million odd dollars of profit, the express companies had to do a business amounting to $132,599,190. Of this amount they paid out nearly half for their privileges on railways, steamboats, etc., or a total of $64,032,126.

The general public belief has long been that the express companies make very large profits from their operations. The statistics, as reported by the Interstate Commerce Commission, do not bear this out. It is true that the profits are large in proportion to the value of the express companies plant. The total valuation of all the real and personal property of all the express companies reporting, 13 in number, is only $22,313,575. Hence the net earnings were over 50% on the book value of the plant. On the other hand, these net earnings are less than 9% of the gross earnings. Statistics of business done show that the average revenue of the companies per piece of express matter handled was 50.49 cts. Hence the average profit of the express company on each piece of matter handled is only about 4½ cts. This cannot be considered an excessive margin of profit and it is evident that a very slight increase in rates of wages to employees or in payments for express privileges would wipe out all profits and place the companies in peril of bankruptcy.

This comment is based, of course, on the assumption that the operations of the companies are correctly reported to the Commission. We fear there may be some skepticism on this point in financial circles. The management of some of the express companies has been long carried on as if it were a private business, and the attempts of stockholders to find out what was being done with their property has been treated as a gross impertinence. This mistaken policy on the part of the express magnates is in large part responsible for the current notions as to the large profits of the express business. It is also responsible for the widespread belief that these profits have been largely distributed to insiders in the management through excessive salaries or favorable contracts.

Under these circumstances we do not think

these Interstate Commerce statistics will be taken as telling the whole story of the express business, either by the public or by Wall St. In order to rehabilitate the express companies in public confidence, the books and records of the companies should be opened to the examination of expert accountants selected by the outside stockholders. Further, it might be a good plan to set some "efficiency engineers" at work to see if the expenses of carrying on the express business cannot be reduced.

Apropos of Mr. Louis Brandeis's recent proposal to have the railways of the country save a million dollars a day by a radical reform in their methods of operation through the adoption of "efficiency engineering," a correspondent suggests that Mr. Brandeis ought not to stop his reform proposals with the railways. He has succeeded in focusing the attention of the nation on efficiency in industrial operation. Now let him grasp a magnificent opportunity and appeal to the court of public opinion for the application of efficiency methods in the business of his own profession—the Law.

There indeed lies a fertile field for the reforming hand of the efficiency engineer. He will not need his stop watch, either, to time the operation of the machinery of justice. A perpetual calendar would be a more useful instrument.

Mr. Brandeis thinks that by efficient management the railways could be run with a much smaller operating force. But if our legal processes were run on as business like and systematic a basis as even the poorest manufacturing plant, we judge that the public could dispense with a large majority of the lawyers which it now has to support, and they could take up some productive occupation.

The more one studies this scheme, the more one is impressed with its possibilities of vast public benefit. Talk about the economies through saving the time of workers on the railway and in the shop whose labor is bought for a dollar or two a day! What do trifles like that amount to compared with economizing the time of attorneys, whose services may be worth, by their own confession (and bills) that much a minute?

Furthermore, our present law shops are run with antiquated machinery. There are sieves which let a lot of bad material pass through and spoil a lot of good material. Poor machinery in a factory plant means merely financial loss, a waste of money and laborers' time; but the poor machinery of the law does far worse harm. Men and women and children are sacrificed through its clumsy operation. Hearts are broken, homes are ruined, fortunes are lost, reputations are spoiled. The whole community suffers grievous harm through bad machinery and incompetent and dishonest operatives in our law shops. The loss in dollars and cents is overshadowed by the damages which cannot be measured in dollars. And all these things can be proved by quotations from high authorities in the legal profession itself.

Surely, then, Mr. Brandeis's greatest opportunity in his mission as a public benefactor—gratis—is in arousing the public to the crying need of efficient operation of our legal machinery. If he can only get a chance for engineers to undertake the reform of the legal profession, he will have accomplished a far larger feat than saving the railways a million dollars a day in expenses.

The people of St. Louis, Mo., are so fortunate as to be able to frame and adopt a new charter whenever they see fit, quite independently of the state legislature. The power of framing a charter is exercised through a body of fifteen citizens, brought into existence for the purpose, while final approval or disapproval is determined by popular vote. Elsewhere in this issue we give some of the leading provisions of a charter which will be adopted or rejected on Jan. 31, 1911.

The proposed new charter is progressive but not radical in character. The council is to be reduced to 15 members—all chosen at large instead of by wards, and there will be only four other elective city officers. This is in accordance with the short-ballot principle, which is now being accepted throughout the country. It gives six more members to the council than are provided under new charter legislation recently adopted at both Boston and Seattle, and three to five times as many council members as are found in the majority of the hundred cities which have adopted the commission or Des Moines plan of city government. This goes to prove our assertion that the new charter is progressive but not radical. Further proof is afforded by the following facts: The recall of any elective officer is made possible at stated intervals, but not at any time the voters see fit. This is at variance with general practice but in general accord with the Boston plan. The referendum is limited to franchise grants to public-service corporations, and is permissive at that. There is to be no initiative, or direct legislation, by the voters.

The mayor and the council are retained as separate branches of the city government, instead of being merged as under the commission plan, and the executive and legislative functions are almost completely separated.

The mayor has full power of appointment of department heads, without confirmation by the council, and with slight exception the power of removal of officials appointed by him is vested in him alone. The mayor is shorn of his old power, under the present charter, of confirming appointments to subordinate places, over thirteen hundred in number. Instead, department heads have undisputed power to appoint their subordinates, except as governed by civil service rules. This is a great step in advance, and is also another example of conservative progress: conservatism in keeping legislative and executive functions separate in theory and progressivism in carrying the theory into practice by effecting an actual and almost complete separation of the two functions. In general, this, as well as a number of other provisions of the new charter, is right in line with the model charter of the National Municipal League.

Concentration of responsibility, primarily in the mayor, and secondarily in heads of departments who are in turn responsible to the chief executive, has advantages evident to any engineer or other man accustomed to efficient methods of business and industry.

The board of public improvements is divided into six departments. The division is on functional lines, except that the department of engineering and construction has charge of all surveys, design and construction, leaving the other departments in charge of maintenance. The charter specifically demands cooperation among the departments, and the board of public improvements is supreme over all. This plan certainly has many advantages over any other that could be devised. It makes for unity and harmony in the various branches of the public service while at the same time ensuring many if not all the benefits of specialization.

Altogether, the proposed new charter of St. Louis has much to commend it and since it is subject to future amendment without need or danger of legislative interference it seems reasonable to hope and expect that it will be adopted by a good majority on Jan. 31.

A Law Requiring Engineers to be Examined and Licensed.

We print on another page of this issue a draft of a law prepared by a committee of the American Society of Civil Engineers and recommended as a model to be followed by the legislature of any state which sees fit to enact legislation restricting the practice of engineering, although the committee also expresses the belief that any such legislation is undesirable.

We earnestly counsel every one of our readers to study carefully this proposed statute and decide for himself whether he desires to be brought under the operation of such a law, or of any law restricting the practice of engineering. If he does not, he will do well to watch carefully the actions of the legislature in his state and exert all the influence that he can command against the enactment of any law injurious to the engineering profession.

If he thinks that such legislation ought to be enacted, he will also do well to keep informed as to what is going on or some law may be placed on the statute books containing requirements which will do him serious injury.

It is particularly to be noted that the [bill] framed by the American Society of Civil Engineers' committee, is made broad enough to cover every engineer and every kind of engineering. The bill applies to "civil engineering"; but it defines civil engineering to be "any branch of the profession of engineering other than military." It confirms this definition by enumerating a long list of "public and private utilities" which it declares to come under the head of civil engineering, among which are "works for the development, transmission and application of power and *electrical, mechanical, mining, industrial*, and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation."

There can be no doubt that the framers of this statute meant it to be broad. The man who does any work as a mechanical engineer or an electrical engineer or a mining engineer or any other kind of engineer (with the sole exception of military work), and who does not pay a fee and take out a license will run risk of fine and imprisonment.

It seems to us that this is an extremely serious matter to engineers. It is one on which they cannot afford to be misinformed. The civil engineers are already becoming awakened to the situation and it behooves the mining engineers, the mechanical engineers, the electrical engineers and those engaged in every other branch of engineering work to realize that their interests are equally at stake.

It is a pertinent question to ask at the outset what the influences are which are seeking to have legislation enacted to restrict the practice of engineering.

It will be admitted by every candid person, on a little reflection that the only thing which can justify such legislation is the protection of the public. Have these laws been introduced by some body of citizens who have become convinced from observation or experience that the public needs protection from the poor work of incompetent engineers? If this is the case it has certainly never come to our knowledge. The fact is that in the state of New York, the movement for legislation to restrict the practice of engineering originated with a secret organization known as the "Technical League" which has for its chief and avowed object raising the pay of the men working in the lower ranks of engineering.

That this object is an eminently desirable one, few will dispute. It is a pity and a thousand pities that men of education, intelligence and experience, who are entrusted with large responsibilities, should often receive salaries little greater and not seldom even less than the wages paid to skilled laborers who are members of a strong union.

But that this object can be attained by any process of legislation, we have never been able to see. On the contrary we believe from twenty years and more of observation and study, that where the experiment has actually been tried of making engineering a "close profession," as it is termed, by legal enactment, the result has been more injurious to the profession than beneficial.

We say this, moreover, with no prejudice against state control in general. On the contrary, as our older readers at least know, Engineering News has been for many years a strong advocate of progressive legislation for state or federal control or supervision of matters wherein such supervision may be beneficially exercised. Nor are we taking the ground that there is no possible matter in connection with engineering in which state control may be usefully exerted. On the contrary, there is good reason to believe that the making of surveys, for example may well be under some official supervision. In many cities, ordinances are in force requiring land surveys to be made by licensed surveyors. Such ordinances, have it is

[illegible] been at times abused, so that incompetent men have been licensed and the work has been made a profitable monopoly of a few men with political influence. This abuse, however, is not a valid reason against such ordinances. It is perfectly practicable to determine the competence of a man to do accurate work as a surveyor; and it is of great public benefit to require land surveys to be made by only such men.

But it may fairly be asked, if a State or a City may require surveying to be done by competent men only, why may not it require that all engineering work should be done by competent men only?

There is no question, whatever, that if this could be accomplished, it would be of great public benefit; but we can conceive of no possible means by which it could be done.

The situation may well be illustrated by the parallel situation with respect to civil service examinations. Such examinations, established by law, have been of great value in the selection of employees for the lower grades of work, according to their competence to fill the position, *so far as such competence can be determined by a set examination.* It is true that such examinations often cause the selection of men who are better at passing examinations than at performing efficient work; but it is at least better to select employees on such a basis than on the basis of their voting a certain ticket or having done political work for a certain boss.

When, however, we come to the higher positions —the positions where executive ability, strong personality, high character, initiative, energy, sound judgment and similar qualities are requisite to success, the examination scheme of selection breaks down completely.

Similarly, if it were attempted by law to subject engineers to an examination which would sift out the men competent to take responsible charge of works, we have no hesitation in saying that the attempt would be an utter failure. Plenty of incompetent men would slip through, and not a few thoroughly able men, of the sort the engineering profession and the public needs, would be excluded.

But this so-called model law, or any law which has ever been offered, does not pretend to do even this much. It sets up a certain minimum standard of requirements merely and anyone who can meet these requirements and pass an examination can have a license and practice engineering.

In the Am. Soc. C. E. bill, these minimum requirements are (1) an age, of 21 years; (2) good character, and (3) experience in engineering work as assistant or otherwise for six years, of which at least one year must be in charge of work. If a graduate from a reputable engineering school, four years experience are sufficient.

In a bill introduced in the New York legislature on Jan. 18, by Mr. McGrath, the minimum requirements are (1) an age of 25 years; (2) good moral character and (3) completion of an engineering school or correspondence school course, with three years practical experience, *or* completion of a four year course in engineering, *or* "five years reputable practice."

In both cases these minimum requirements refer to admission to the examination, and the theory of the law in each case is that the candidate who can meet these requirements and successfully pass the examination can then receive the official certificate of the State that he is competent to take responsible charge of work.

Now if engineering were a single definite occupation, there might be possibilities of some measure of success in this sifting process; but engineering is a hundred different occupations and professions and no man is wise enough to draw a hard and fast line where one leaves off and another begins. The law utterly ignores this. It takes a man who has studied and had experience, let us say in sewer construction, for the requisite term and brands him officially as authorized to undertake any sort of engineering work. He may build railways or bridges, ships or machine tools; he may take a job on highway construction or report as an expert on a mine proposition.

It may be said that no honorable engineer would undertake work he was not competent to perform; but that is true today. The ostensible object of the proposed law is to protect the public against the pseudo-engineer who is ready to undertake anything because he needs the money. Let the pseudo-engineer once get his license and see how many and various are the fields of engineering which he will pretend to cover, all under the authority and protection of the law!

But this is only one of the reasons why the alleged protection of the public against incompetent engineers, which the law ostensibly affords is a farce. What constitutes a competent engineer? Education and experience are important qualifications no doubt; but they are by no means the only qualifications. Yet the law concerns itself with them alone. The "character" which the law prescribes means of course practically nothing. There is nothing to shut out the engineer who makes money "on the side" by collecting commissions on the goods he specifies and the purchases he makes for his client. There is nothing to shut out the engineer who has a good enough intellect but a weak will so that he can be swung this way and that by opposing interests. There is nothing to shut out the engineer who is prone to ride hobbies, so that his judgment cannot be relied on. There is nothing to shut out the lazy man, who will take things easy whether his client's interests suffer or not.

And yet this bill is put forward ostensibly to protect the public against incompetent engineers!

It seems to us that there is a real and serious danger in such a law. The danger is that the public will be misled and think the State's label upon an engineer really means what it pretends to mean. The pure food label is a fine thing where you can by analysis and inspection test the composition of what is in the package. But otherwise a pure food label is worse than nothing because it throws the purchaser off his guard.

And if a law for licensing engineers doesn't benefit the public, does it benefit the engineers? It is we know, the fond belief of many of the younger men in the profession and particularly of many engineering employees that the law will benefit draftsmen and instrument men and inspectors and other employees and enable them to command higher pay than they now receive. But how will this result be obtained? We confess ourselves wholly unable to see. The bills before us each relate to the practice of engineering. There is nothing to indicate that the assistants which an engineer employs in drafting or field work or inspection or even in responsible charge of work would require examination and license. In fact the law specifically requires that candidates to receive a license must have had previous experience as assistants to a licensed engineer. The wages of engineering employees after the passage of the law as now would be subject to the law of supply and demand. So far as the law would have any influence, its tendency would be, it seems to us, toward the concentration of engineering work in the hands of large firms, the heads of which would be licensed engineers. We believe the trend in this direction is strong enough already without any aid by legislation.

It is imagined we suppose, by those who have promoted this legislation, that the requirement of examination and license by the State would so restrict the number of practising engineers as to give them better chances for business and opportunities to earn higher fees. From a pretty broad knowledge of engineers and engineering, extending over many years, we fail to find in this idea anything more than imagination. There is no lack of engineers who can meet the requirements laid down in the law; and the examinations will be either made easy enough to let through the great majority; or, if they are made difficult, they will let through the scholastic engineer not long out of college and will work grievous injury to the men of large experience and ability who are unable to make any good showing in passing an examination.

There is only one certain thing about this proposed legislation. That is that if it is enacted, a tax will be laid on the practise of engineering. This tax, by the bill now before the New York legislature is $25. At least as much more must be added for the expense an engineer will be under in traveling to and from the place of examination and other outlays. Further, we advise our readers to reflect that this is only the beginning. The State governments are all looking for new sources of revenue and a tax once laid on engineers it will be easy to increase it.

We fear that if those junior members of the engineering profession who have promoted this legislation are finally successful, they may, years hence, recall Aesop's fable of the frogs who petitioned for a King and over whom a stork with a good appetite was sent to reign.

Doubtless our criticisms of this proposed legislation may be unwelcome to some of our readers who have become honestly convinced that in some such measure lies hope for betterment of the engineers lot. It is none the less our duty to present the facts as we see them, for in this proposed legislation, in our opinion, is embodied serious injury to the public and to the engineering profession. We should be derelict in our duty therefore, did we not present this situation to our readers.

Our opinion, moreover, that any legislation restricting the practice of engineering is unwise and injurious coincides with the opinion of the leading men in the profession, almost without exception. The governing body of the American Society of Civil Engineers has by formal resolution declared that "it does not deem it necessary or desirable that civil engineers should be licensed in any state." At the annual business meeting of that Society last week, at which more than 600 of the leading engineers of the United States were present, a resolution was adopted by all but unanimous vote expressing the opinion of those present that legislation restricting the practice of engineering is undesirable.

We hear, however, opinions expressed that such legislation is bound to come and the best that engineers can do is to exert their influence, to the end that such legislation may be made as little injurious as possible.

We do not subscribe to any such doctrine. The fact is that there is absolutely no public demand for any such legislation. The movement for it has arisen from men who desire to better conditions in engineering work and who are obsessed with the unfortunate idea that the law can be made effective for that purpose.

We submit that any such influence ought not to be strong enough to tie up the profession with red tape, nor need it if engineers as a whole will bestir themselves. The engineering organizations ought every one of them to make its influence felt and felt powerfully. If any engineering society is so organized that it cannot take prompt and effective action, for the protection of its members' interests, it had better amend its constitution or disband.

Individual engineers, moreover, may make their sentiments known to their representative in the legislature. We do not believe that there is any need of the profession submitting to any such restrictions upon its work as are proposed if its members will inform themselves and speak out in their own defence.

EXTRACTS FROM RECENT PERSONAL LETTERS TO THE EDITOR FROM WELL-KNOWN ENGINEERS.

"I enclose a letter from a well-known firm of manufacturers, and would call your attention to the part underlined. I thought that this sort of thing had disappeared, but evidently it has not."

[Extract from inclosure]: "To Consulting Engineers we pay a commission of 10% on any sales they may be enabled to influence for us, which is paid at the time collection is made for the machine."

"I think as I look back on the task of enlisting capital for this enterprise, the fact that stands out the worst in the whole experience is the amount of bitter feeling there is in the minds of capitalists all over the world against the engineering profession; and this bitter feeling, in almost every case that I encountered, was justified by facts. Time after time it has come out that engineers' estimates were nothing more or less than mere guesses, and 100% of error is as common as fleas on dogs."

LETTERS TO THE EDITOR.

Traffic on Waterways and Railways.

Sir: I have noticed your courteous treatment of my waterway article in Engineering News of Jan. 5, with which I am pleased.

There was one fact which was mentioned which has had no engineering comment, but which I think is of a great deal of importance, and which, indeed, aroused a good deal of interest among the laymen. This is my statement, that, in my opinion, it took less power (i. e., foot pounds) to move 10,000 lbs. of freight on a low-grade railway than in slack water. I do not know of any dynamometer records, but I have put up the question to a number of engineers, who have assured me that I was undoubtedly right.

In another number of Engineering News I notice you have commented on the statement made by me that a single track railway handles upwards of 3,000,000 tons per track mile per year. The Wabash Ry. has several divisions on which this record (or better) is sustained, and these are divisions on which a very considerable passenger business is done. The Wheeling & Lake Erie Ry., which has a rather small passenger business, is able to handle on a single track road, close to 5,000,000 ton-miles per annum.

Yours very truly,
F. A. Delano,
President, The Wabash Ry. Co.

Chicago, Jan. 17, 1911.

The Wreck of the Henke Building.

Sir: The latest wreck in reinforced concrete described and illustrated in your issue of Dec. 8, 1910, p. 636, is just another finger of scorn pointed at the engineering profession.

In spite of what the findings may be of the men who are investigating this wreck there is enough in the photographs of the building to condemn its design and place it in the large class with all of the other great wrecks of reinforced-concrete structures. They may find a shaving or a wooden block in the wreck of one of the columns or build a worthless theory on a splinter, as has been done before, but the glaring truth stands out that plain concrete shafts are unfit to support heavy loads, and slender rods in these shafts do not reinforce them; also this harvest of death emphasizes the absolute need of a unifying element in all reinforced-concrete structures.

The pictures of this wreck show two features of its design that condemn it, and yet one could read engineering literature concerning reinforced concrete for days without ever finding a hint of the danger of these features; one can also find many examples of these erroneous features in the work of experts of national prominence. Here is where the profession is to blame for these wrecks.

In Engineering News, in 1906, the writer pointed out the error in depending upon longitudinal rods in a concrete column. He has at various times condemned such design publicly in the most emphatic manner possible. A large reservoir roof in Madrid, a hotel in California, a building in Rochester, another in Philadelphia—all of these, the greatest wrecks recorded, had longitudinal rods in the columns. They could not possibly have failed as they did, if they had had tough steel columns or properly hooped reinforced-concrete columns.

I have repeatedly flaunted these facts in the face of the engineering profession and challenged contradiction. In my paper "Some Mooted Questions in Reinforced Concrete Design" read last March before the American Society of Civil Engineers and very widely discussed, I made very prominent a severe criticism of this flimsy method of design. Only one critic came forth with anything resembling an argument, and he, by averaging an indiscriminate lot of hooped and other columns with steel in them, tried to satisfy himself that nursery columns are greatly strengthened by slender longitudinal rods. By cutting out four of these nursery tests in one group the averages for that group would tell exactly the opposite tale. This is supposed to be careful investigation! Some of the tests with no steel whatever were 25 and 50% stronger than other with steel rods in them. Astounding as it may seem the very pamphlet that shows these results, written by one of the best known authorities in this country, *recommends the addition of 17 to 20% to the strength of plain concrete columns for each per cent. of slender steel rods added*! Nearly all books on the subject are guilty of the same gross errors. It is time for plain speaking in this matter. Why do not these authorities come out and demonstrate their position with something better than a lot of averages that mask more than they reveal? Or else why do they not acknowledge their error?

The nursery columns, loaded perfectly central, tell only a part of the weakness of these columns in a monolithic building. The least movement or settlement in such a structure, with no articulation and no toughness, puts excessive strains on the weakest part of the frame. In this construction it is the columns that are designed as mere props with no ability to resist bending. Cracks in these mean spalling and stripping of the concrete and disaster.

In one wreck the entire reinforced-concrete roof of a large building collapsed, because the concrete had been frozen and was not set. The top floor and the columns below it were not hurt. The columns were octagonal and were hooped. Their toughness saved the building. All this despite the fact that under test it developed later that the floors were not capable of carrying their supposed safe load.

The unifying element referred to in the first part of this letter as being absent in the Cleveland building is continuous rods through the columns to tie the beams together. In a steel building this is supplied by the rivets. In many reinforced-concrete buildings it is lacking. There is no sign of any such design in the photographs of this building. There is no doubt whatever that tenacity is the one thing that a reinforced-concrete structure needs both as a whole and in all of its members, particularly the columns. A column that can bulge out or be spalled off by the mere overcoming of the weak and uncertain tenacity of plain concrete is an unsafe column for heavy loads. Highly stressed slender rods aid in this bulging tendency and hence menace the strength of the column they are supposed to reinforce.

It is a shame and a burning disgrave to the engineering profession that no more is learned from investigations of disasters such as this than that practical construction is not absolutely perfect, materials are not absolutely clean; such reports could be written thousands of miles away from the wrecks. The tremendously important lesson is ignored that these columns are absolutely untrustworthy.

If a man should aim a revolver point blank at another's heart, and wound him instead through the lung, and if the other man should fall dead of heart failure at hearing the report of the shot, physicians might demonstrate that death was due to fright at hearing the noise and that a cannon cracker might have produced the same effect, and they might clear the murderer by this technicality. If it is found that there was a bad batch of concrete somewhere that set off this wreck it would supply a technicality such as the other, but it will not clear the engineering profession of wilful ignorance.

It is the profession, as represented by its leaders in framing literature and its foremost members in the reinforced concrete field, that is responsible for this wreck and not the individual designer who may have done his utmost in following standard, though abominable, practice.

Edward Godfrey.

Monongahela Bank Bldg., Pittsburg, Pa., Dec. 19, 1910.

[As shown by the date, the above letter was received at this office long before the issuance of the report of the Commission appointed to investigate the collapse of the Henke building. It was thought best to withhold it from publication until this report, published on another page of this issue, was available. It is now printed with the recent approval of its author.—Ed.]

Formula for the Purchase of Coal on the Heat-Unit Basis.

Sir: Will you please tell me what is the matter with the formula on p. 563 of your issue of Nov. 24, or with my understanding of it?

Let a = B. T. U. per lb. dry coal.
b = % dry coal × 2,000.
c = 0.5 × % ash.
B = price bid per ton.
P = price to be paid per ton.

$$A = \frac{a \times b}{B + c}$$

$$P = \frac{a \times b}{A} - c = \frac{a \times b}{\frac{a \times b}{B + c}} - c = B + c - c.$$

$$P = B.$$

The price to be paid equals the price bid!

Wm. Kent.

Montclair, N. J., Dec. 5, 1910.

[The above inquiry was submitted to the Department of Public Works, Chicago, and we have the following reply from Mr. Henry A. Allen, Consulting Engineer.—Ed.]

The query attached to your letter can be answered by the following question: Why should not the price paid for coal equal the price bid if the characteristics of the coal delivered agree on analysis to that proposed? The entire difficulty is due to printing but part of the proposal and specifications.

The table for "Guarantee," requires the bidder to state in his proposal the following characteristics of his coal: B. T. U. per lb. dry coal, percentage of ash in dry coal, percentage of moisture in delivered coal, and price per ton.

That bidder guaranteeing to deliver coal containing the highest number of B. T. U. for one cent, other conditions being complied with, is the lowest bidder is entitled to be awarded the contract. In other words, the bidder has guaranteed to furnish a given amount of heat for one cent designated in our formula as C. B. T. U. Should the contractor be able to furnish coal having exactly the same characteristics as guaranteed then the price bid would equal the price paid.

It can be seen that it is distinctly stated in the specifications how the guarantee is determined. Then the actual price paid is based upon the guarantee as the characteristics of the coal are determined by analysis of delivered coal.

Prof. Kent's statement of formula should be as follows:

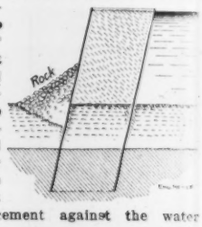
a = B. T. U. per lb. dry coal, as guaranteed.
b = % dry coal × 2,000, as guaranteed.
c = 0.5 × % ash.
a' = B. T. U. per lb. dry coal, as delivered.
b' = % dry coal × 2,000, as delivered.
c' = 0.5 × % ash, as delivered.
B = price bid per ton.
P = price to be paid per ton.

$$A = \frac{a \times b}{B + c}$$

$$P = \frac{a' \times b'}{A} - c'$$

More Suggestions as to the Steel Pile Cylinders Around the "Maine."

Sir: As competent engineers have calculated that the water pressure on the outside of the proposed cylinders around the sunken "Maine" would overturn them—most probably by letting the mud filling slip down inside—and as such an outcome would be an unspeakable catastrophe, could not the steel piling be driven on a batter as per enclosed sketch—thus getting some of the weight of the filling and reinforcement against the water pressure?



David Fleming,
Civil Engineer.

Ganahl, Est. S. L. P., Mexico, Jan. 12, 1911.

Sir: I have been much interested in the discussion concerning the cofferdam to be built around the wreck of the "Maine." It is evident that the stability of the dam will depend upon how liquid the saturated clay will be with which the cylinders are to be filled, and this will depend very much upon the character of the clay. There are clays, undoubtedly, which will part with much of their water when under pressure, and become stiff. Such clays would produce a lower hydrostatic pressure upon the walls of the cylinders than you have assumed. There are, however, other clays which when once saturated part with their water very slowly. A notable example of this was the clay used in the Necaxa Dam in Mexico, which caused the disastrous accident described in your issue of July 15, 1909.

The clay used at Necaxa, according to the statement of the Chief Engineer published in that issue, remained practically a liquid, even though it had opportunity to drain out through the loose-rock slopes of the dam on either side. The pressure of the clay on top, filled in to 100 ft. or more, seemed to have no effect in squeezing out the water. I believe this object-lesson of the Necaxa Dam ought to be remembered by every engineer who has the responsibility for building cofferdams to be filled with clay.

J. M. B.

St. Louis, Mo., Jan. 13, 1911.

Technical Education in China.

Sir: I have read with great interest the extract from an address that you published on Aug. 11, 1910, in which was an account of the work that is being done at the Pei Yang University of Tientsin.

This university undoubtedly ranks by far as the foremost government technical school in China and one need not hesitate in calling the engineers, that graduate from there, as well equipped in point of instruction as they would be were they to get their education abroad. However, in reading over this article, the impression might be conveyed that the school in Tientsin is a typical one and quite representative in efficiency of what is being done in similar institutions throughout the Empire. This is far from true as I have learned from experience and in visiting various government colleges.

Believing that the matter may be of interest to you I am enclosing copy of a letter I received from one who has been interested in educational work in China and whose letter explains the present situation in a nutshell. I also enclose copy of my own letter which covers the points wherein the general run of Chinese Government colleges differ from the admirable institution at Tientsin.

In the present wonderful program of reform that the Government is carrying out, we cannot find a better illustration of the sensible initiative that is back of her endeavors, than the starting up, in the various provinces,

the so-called "Imperial Polytechnic Colleges." From these colleges China hopes to turn out her future engineers to take part in the development of her vast resources and thus have the country developed entirely by her own people and it will be "China for the Chinese" from start to finish. This is as it should be, but under the present system, where the whole school organization has come under the baneful influence of Chinese officialdom, the hope seems to be a forlorn one.

Yours truly,

"An American Teacher."

[The letter of this "American Teacher" to the unnamed person, long interested in Chinese education, is given below and is followed with the reply received by the "American Teacher."—Ed.]

Dear Sir:

My object in writing to you is to make known the conditions, as I see them, that foreign teachers are meeting with in the Chinese Government Colleges. Since these schools are subject to the rules laid down by the Board of Education in Peking, I would like to make a statement to that body, but I prefer to write to you first.

I am teaching engineering subjects in an institution, which is one among several of like nature that have recently been started up in the Provinces. I believe this school is typical of most of the Chinese Government Colleges in management and facilities for instruction. Briefly, the conditions are these: The school is in direct charge of Chinese officials who know no English nor Western education and it is their duty to see that the program, as directed by the Board of Education, is carried out. All matters, therefore, that do not conflict with the rules issued by the Board relating to curriculum, purchases, etc., must be left to the decision of the Director of the College. The instructor must make his wants known through an interpreter. In my case there is no interpreter, so I use the students themselves.

The students are required to take 36 hours per week of all college subjects and these hours are taken up in the study of as many as 14 different subjects during one term's work. This would be too much work for the average college student in America to carry, but ought, especially, not to be thought of in the case of the Chinese, who are under the big disadvantage of studying in a foreign language.

The great difficulty, of course, is the handicap that the students must work under due to the entirely inadequate preparation in the study of English previous to entering on college work. This preparation, in the case of my students, amounts to only two years, where the time should be at least eight years. This is the requirement in the Imperial Pei-yang University of Tientsin where men with foreign education are in control and the school is an exception to the general run of them in China.

It is impossible for the instructor to make himself clearly understood in the class room and recitations are quite out of the question. The work of the teacher is therefore mostly lecture work and he gives out information from which but very little is absorbed, by the majority. Only the very bright students are able to get along. However, poor and good students must graduate alike, as the teacher is not allowed to fail any student, no matter how poor in his work he may be. All are required, according to the provisions of the Board of Education, to graduate together within a specified time.

I mention these points as among the principal ones which account for the fact that almost all the American teachers who come to China for a certain term, always return home on the expiration of their contracts.

There is a remedy for this and I should say that it lies within the power of the Board of Education to require that:

(1) Students must have a certain sufficient preparation in English to enable them to study college subjects intelligibly.

(2) Students must have adequate training in the various subjects leading to college work; preparatory schools should be started up where necessary or a preparatory department should be started in the college itself.

(3) The head of the school should understand the subjects over which he has control and not be totally ignorant of Western education.

(4) Teachers should have some authority in arranging the work and in adapting the program of studies to the needs of the students.

(5) The teacher should have authority to remove from classes unwilling or unprepared students, who only retard the progress of the class.

It seems that the schools of China will play a most important part in the future development of the country and there is indeed no better sign of China's greatness than the eagerness the people have for the acquirement of an education. There ought to be a great field here for American teachers. There are opportunities for research and investigation along original lines that go hand in hand with the modern upbuilding of the country, especially when we think of the vast mineral resources that will eventually be developed and the attendant stimulus to progress in all lines of engineering. China is certainly in the foremost rank as the mining field of the future.

With these opportunities in view, it is a keen disappointment that foreign teachers (the most of them being Americans) should find themselves compelled to leave the work that they have started on.

It is obviously an advantage to American trade that American teachers be employed in China's technical and industrial schools, since American machinery and American methods are given first attention in the study of up-to-date practice. I find that American manufacturers are taking an interest in keeping themselves in touch with the schools here even more so than at home.

I feel that I am imposing too much upon you in writing at such length, especially since the substance of this letter really is meant for the Board of Education alone. I propose to write to them along the lines of the five points I mentioned and I want to ask if I could not have it passed to the Board through your hands. Also I should greatly appreciate to have any suggestions or advice that you may want to offer or whether you think it worth while to write to the Board at all so far as its doing any good is concerned.

Yours very truly,

"An American Teacher."

Dear Sir:

As you may know, I have been for many years engaged in educational work, so that I have had a practical experience of the difficulties to which you call attention. The modern educational work carried on previous to the organization of the Board of Education and the abolition of the old system of examinations was much more thorough and satisfactory than that which has been carried on since, because those in charge of the modern schools formerly had more independence and could conduct the schools in a rational manner according to the needs and attainments of the students. With the abolition of the old system of examinations and the organization of the Educational Board and the Educational Bureaus of the Provinces, the old literary graduates came into full control of the new school system with disastrous results to the efficiency of school work.

I have learned that the Pei Yang University got such a momentum of its own, and that it has been so fortunate in its Chinese President that its efficiency has not been crippled. The Provincial High School at Paotingfu has suffered more but is still somewhat effective, through the tact which the foreign teachers have shown in dealing with a difficult situation. The Middle Schools of Chihli Province, with one or two exceptions, have lapsed into a hopeless state of inefficiency. I am writing this brief sketch of the conditions of affairs in the North as an introduction to the real reply to your letter.

In my opinion, while the control of educational matters remains in the hands of the Hanlin crowd, whose only ambition is to fill all the places of authority with members of their own clan, and who are only interested in working out a high-sounding scheme of education without regard to whether it is real or spurious, it is quite useless to make representations to the Board of Education, or to any other body of Chinese officials. The only course is for the foreign teacher to secure the best conditions that he can by tact in dealing with his Chinese director or supervisor, and turn out as many sound scholars as he can.

The reform of the present condition is going to come when the body of young students themselves perceive that mere graduation certificates are of little value and demand real solid education. There are indications now that this feeling is growing among the young scholars and in time the question will solve itself. The present generation of incompetent directors of education will be superceded by men who know their business. Americans have no right to interfere with Chinese educational arrangements, nor, in my opinion, would it be good policy for you or any other foreign teacher to try to approach the educational authorities as they are at present constituted.

Yours very truly,

"A Former Teacher."

Sheet Piles as a Means of Decreasing Permeability of Porous Foundations.

Sir: In your issue of Dec. 29, 1910, p. 708, in Mr. W. G. Bligh's article on "Dams, Barrages and Weirs on Porous Foundations" it will be noted that Mr. Bligh recommends sheet piling as an aid towards decreasing percolation under an earthen dam. I think it should not be taken for granted that engineers are anywhere near to being a unit as to the efficiency of piling for such purposes. It has often been pointed out that the pressure head becomes increased to that degree corresponding with the depth of the lower end of the piling. Ordinary sheet piling is not impervious, and very few methods of piling are, so that in practice, the 24-ft. length of base assumed as saved in Fig. 4 of Mr. Bligh's paper may not be saved. But in any case the increase in head would be there, and even assuming the piling to be tight, the 24 ft. would be reduced to 15 ft. by taking the proportion of 20-ft. head to the actual head of 32 ft.

Furthermore, the percolation would not likely travel vertically from the foot of the pile on the downstream side, but would finally find the hypothenuse of the triangle from the foot of the pile towards the toe of the embankment, which distance would be very little more than the horizontal distance from the top of piling to toe. The actual gain (as shown in the accompanying figure) would then be only 12 ft. on the upstream side of piling plus the difference between the hypothenuse ($A\,C$) and the base ($A\,B$), all reduced by the ratio of the two heads. Thus, in this particular case, the gain by the use of the curtain wall is

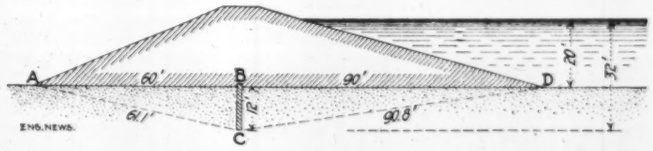
$$(12 + A\,C - A\,B)\,\frac{20}{32} = 8.18 \text{ ft.}$$

instead of the 24 ft. claimed by Mr. Bligh.

If a claim be made that the water would travel vertically down and up the piling, because it can travel on the skin of the piling more readily than through the sand, then 1 ft. of pile surface is not equal to 1 ft. of sand percolation, and the above still holds. And again if we accept the hypothenuse $A\,C$ why not the hypothenuse $C\,D$, which would again reduce the 8.18 ft. to

$$\frac{20}{32}\,[(61.1 - 60) + (90.8 - 90)] = 1.18 \text{ ft.}$$

instead of 24 ft.



There is nothing to show that the water would follow the sub-base line of the superimposed structure until it came up against the piling. The weight of this structure would naturally compress the sub-strata of sand for some distance downward, and the line of least resistance for the percolation of the water would, in all probability, be the lines $C\,D$ and $C\,A$.

I do not wish to detract from Mr. Bligh's interesting paper at all. Sheet piling for the purpose mentioned, however, should have the correct value placed upon it. In most situations it is expensive and troublesome. Driven through sand and well into a non-porous substratum the case would be more in its favor.

John S. Fielding.

13 Toronto St., Toronto, Jan. 4, 1911.

[We submitted the above communication to Mr. Bligh, and have received from him the following reply.—Ed.]

Sir: In reply to Mr. Fielding's letter regarding the length of enforced percolation in the sand foundation of an impervious superstructure, experiments made some 15 years ago in India have conclusively proved that the line of the travel of the percolating current does not, as might reasonably be supposed, take that of least resistance, but as a matter of fact hugs the base and sides of the obstruction, whether this be horizontal or vertical. This view has long been accepted by irrigation engineers in India and Egypt, and is thus no new matter. The proof was afforded by piezometer observations.

W. G. Bligh.

44 Dupont St., Toronto, Can., Jan. 11, 1911.

Notes and Queries.

The Strength of Tank Roofs.—A hard problem is put by A. O. M., who asks for methods of figuring a tank roof, shaped to the segment of a sphere (or, if preferable, any other flat dome shape), the roof to be self-supporting (i. e., having no trusses or stiffeners under it) and to be capable of carrying wind and snow loads and various concentrated loads. The tank taken for illustrations is 60 ft. in diameter; the roof has a rise of 6 ft.; snow and wind are to be taken for ordinary conditions; and a group of two concentrated loads of 300 lbs. each, 3 ft. apart, placed anywhere on the roof, is to be provided for. We shall be glad to hear from any engineer who can offer a practical solution of this problem.

Through an oversight, the capacity of the Garbage Reduction Works at Columbus, Ohio, described at length in our issue of Nov. 17, 1910, was omitted. Mr. I. S. Osborn, Engineer in Charge of improved garbage and refuse disposal at Columbus, informs us that the machinery composing the plant was guaranteed to handle 80 tons in 12 hours or 160 tons in 24 hours; also that the digestors and presses exceeded this guarantee by 20% on a test of winter garbage and will easily handle the guaranteed capacity. In the latter part of December, 1910, the plant was handling nearly the whole of the

garbage of the city in a single eight-hour shift. Through modesty, we presume, Mr. Osborn did not state that the general plans for the reduction works were made by him. The various portions of the machinery or equipment were, however, designed by the manufacturers in accordance with Mr. Osborn's general plans. It may be added that for six years previous to his engagement with the city of Columbus, Mr. Osborn was Chief Engineer for the Edson Reduction Machinery Co., of Cleveland, Ohio, which company made a specialty of designing, manufacturing and installing garbage reduction apparatus. The Columbus plant was the fourth complete garbage reduction works designed under Mr. Osborn's supervision. In fairness to Mr. Osborn, it should be stated that the information given in this note has been contributed to us by him at our request, in order to supplement the information given in his article.

Since reprinting, with editorial comment (Eng. News, Jan. 5, 1911), portions of a report by the committee the Engineers' Society of Western Pennsylvania in which the suggestion was made for an Engineering Section in connection with future conservation congresses, there has come to hand the December Journal of the New England Water Works Association. On page 629 of the Journal, there appears a report made by Mr. G. H. Benzenberg, M. Am. Soc. C. E., on behalf of the committee appointed to represent that Association at the St. Paul Conservation Congress of last September. While Mr. Benzenberg did not suggest an Engineering Section for future conferences, he did, we believe, quite independently make the same general comment as did the committee of the other society regarding the general character of the proceedings of the conference. We quote Mr. Benzenberg's report as follows:

> Comparatively little was accomplished by the congress, most of the time being taken up by the speakers on the question of state rights versus the right of the federal government to develop and control the natural resources, and by addresses. Aside from that by the president and that by Mr. Roosevelt—which may be useful for political purposes—very little of a really practical nature was submitted. The representatives of technical societies did not constitute a factor of the congress.

Our attention has been called to the fact that in the above-mentioned editorial note (page 18, Jan. 5, 1911) the words "Western Society of Civil Engineers" were substituted for the "Engineers' Society of Western Pennsylvania." This was, of course, a slip of the pen. The name of the Society was correctly given in our preface to the section of the committee report which we reprinted.

Mr. Frank L. Thomson, Corpus Christi, Tex., enquires as to the probable life of creosoted piles on the Texas coast. In Engineering News of March 11, 1909, p. 277, Mr. W. G. Arn, Ass't Engr., Illinois Central R. R., reported that pile foundations of bridges on the New Orleans & Mobile Division of the Louisville & Nashville R. R. were in excellent condition after more than 30 years' service in tidal waters. On none of the bridges were more than 10% of the piles defective. A writer of a letter in the issue of Jan. 21, 1909, reported that piles in a wharf at Cartagena, Colombia, S. A., showed absolutely no signs of decay after 12 years' service. An article in the issue of Jan. 7, 1909, describing the pile bridge from Galveston Island to the mainland in Texas, notes that southern pine piles, treated with 24 lbs. each of anhydrous creosote, were in perfect condition after 14 years' service. The article by Mr. W. D. Faucette on "Marine Wood Destroyers in the Waters of the South Atlantic Ports" in our issue of Jan. 5, 1911, p. 12, also gives some data on the subject.

New Tie-Plates of the Pittsburgh & Lake Erie R. R.

Two special forms of steel tie-plates have been adopted by the Pittsburgh & Lake Erie R. R., one of these being for ordinary track and the other for track on bridges. Both of these were designed by Mr. J. A. Atwood, M. Am. Soc. C. E., Chief Engineer of the railway.

Tie-Plates for Ordinary Track.

The form of tie-plate adopted for ordinary open track presents a number of interesting features in regard both to its design and its attachment to the tie. It is recognized as an essential that the plate should be attached immovably to the tie without relying at all upon the rail fastenings. But instead of being made "self-attaching" by the use of flanges or spurs to be embedded in the wood (so as to make the plate an integral part of the tie), it is attached by fastenings which are independent of the rail fastenings. This tie-plate is shown in Fig. 1, and it will be seen that it is attached to the tie by two screw spikes, while the rails are held by ordinary drive spikes. The screw spikes are set at a slight angle from the vertical, being perpendicular to the inclined face of the plate. This avoids a special shaping of the plate (which might be difficult to roll) or the use of beveled washers to enable the spike to be placed vertically.

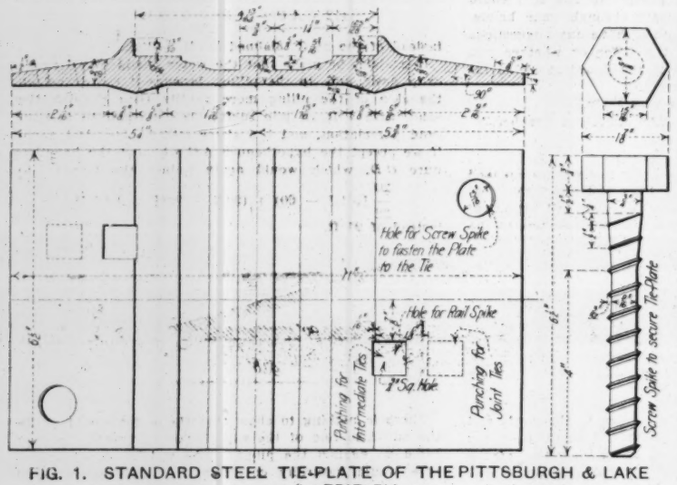

Hole for Screw Spike to fasten the Plate to the Tie
Hole for Rail Spike
Punching for Intermediate Ties
1"Sq Hole
Punching for Joint Ties
Screw Spike to secure Tie-Plate

FIG. 1. STANDARD STEEL TIE-PLATE OF THE PITTSBURGH & LAKE ERIE RY.

The screw spikes are to fasten the tie-plates to the tie; the rails are fastened by ordinary drive spikes.

Other features of the tie-plate, in addition to the use of independent fastenings, are (1) the large area of bearing, (2) the increase of thickness at the edges of the rail seat by adding material to the bottom of the plate, (3) the use of a shoulder on both sides of the rail seat, and (4) the grooving of the rail seat in such a way that the rail base is supported only at the middle and edges.

The wheel load provided for is 30,000 lbs., with a liberal allowance for impact, and in order to reduce the pressure and stress upon the wood (oak) the plate was made 6½ × 11 ins. The thickness should be no greater than that required for the necessary stiffness, and a thickness of ⅝-in. at the rail seat was adopted as a compromise between a thin plate and a thick plate of excessive cost. This thickness, however, was found to be insufficient at the edges of the rail seat, as it failed to fully develop the strength of the end of the plate with the wood pressure assumed (850 lbs. per sq. in.). The two alternatives were to thicken the plate throughout or to add a ridge of metal in the bottom of the plate under each of these weak points. The latter method was chosen for economic reasons, as adding less to the weight and cost of the plate. The objection against the crushing of the wood fibers at these points was considered to be more than counterbalanced by the economic advantages. After the plates are in place, the passage of six or eight trains is sufficient to crush down the fibers of the ties under these ridges so as to give a full bearing on the tie for the whole bottom area of the plate. For the ends of the plate, a thickness of ¼-in. was adopted arbitrarily.

The double shoulders are provided for the purpose of relieving the spike of the duty of keeping the rail to gage. By this method the driven spike merely keeps the rail and the tie together. In practice the driven spike is put in place several days in advance of the work of placing the screw spikes, thereby allowing the plate to be firmly seated on the tie before the screw spikes are put in place, which work is done by power driven tools. The clear width of rail seat between the shoulders is 5 13-64 ins., and as tie-plates are made for the 100-lb. (B) rail section of the American Railway Association, this leaves a total clearance of 1/16-in. between rail base (5 9-64 ins.) and the tie-plate shoulders.

The removal of metal from the upper face of the plate, at the rail seat, reduces the weight but is not sufficient to reduce the stiffness. The total width of the grooves is 2½ ins., or nearly half the width of the rail base.

These plates are of steel, and are made by rolling to shape, shearing to length, and punching for the fastenings; the operations being simple in each case. They weigh 18 lbs. each. They have been used on all track work done in 1910 and are giving excellent results, so far as can be determined by six months' service.

It is of interest to note that the feature of grooving the face of the rail seat (which has been embodied in the above and in several other modern designs of tie-plates) dates back to the early days of railways. A rail-joint with grooved tie-plates was used on the Bonn-Koln Ry. and some other German railways about 1840. The groove served the purpose of enabling differences in height of abutting rails to be adjusted by the insertion of thin iron shims. A similar groove was used also at about the same time in cast-iron chairs which carried flange rails (Germany) but were of similar form to the chairs ordinarily used for supporting double-head rails. About 1887, the late J. W. Post (Chief Engineer of the Netherlands State Railways, and inventor of the Post steel tie and steel tie-plate) designed a heavy tie-plate having the longitudinal grooves in the rail seat. We are informed, however, that none of the plates were made in this way. The object was both to lighten the weight and to allow the escape of sand or dirt which might work under the rail.

Tie-Plates for Long-Span Bridges.

The tie-plates for use on the Ohio River cantilever bridge at Beaver, Pa., are shown in Fig. 2. They are flat-bottom plates having a uniform

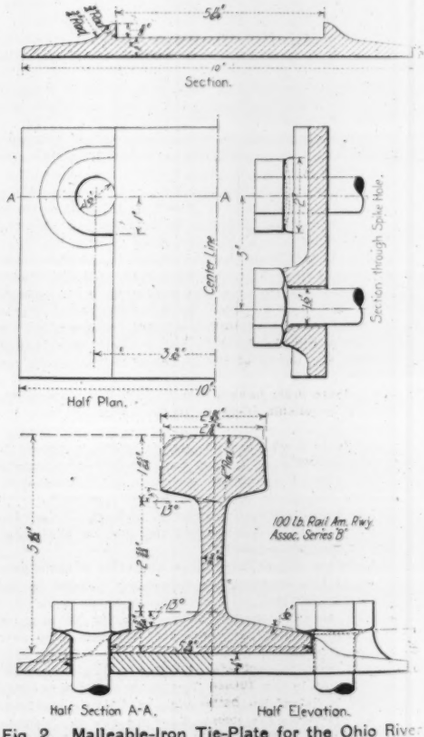


Fig. 2. Malleable-Iron Tie-Plate for the Ohio River Cantilever Bridge at Beaver, Pa; Pittsburgh & Lake Erie Ry.

thickness of ½-in. under the rail (with no groove in the rail seat). They have double shoulders giving a clearance of only 1/32-in. between the widths of the rail base and the rail seat. There are two screw spikes to each plate, and these

e as attachments for the rail and the plate. A special feature of the design is that at each spike hole the plate has a boss of such height that when the spike is screwed home upon this boss it does not touch the rail, there being a slight clearance between the rail base and the spike head. Thus the rail is free to move longitudinally upon the tie-plate. The object of this design (in combination with the use of special anti-creeping devices noted below) is to allow the rails to take care of expansion and contraction between any two fixed points on the bridge.

The bridge is designed to provide for expansion and contraction movements at the roller ends of simple spans, at the anchor ends of the cantilever anchor arms, and at the ends of the suspended span in the main cantilever span. At

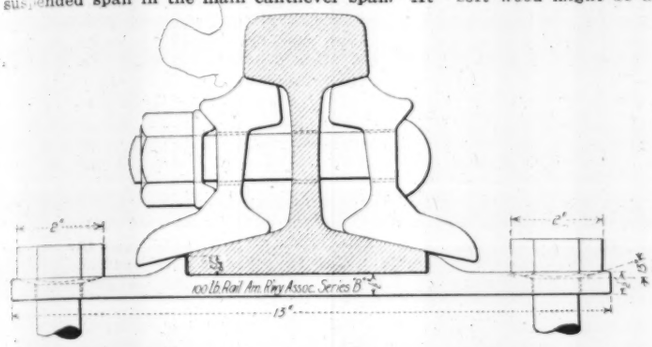


FIG. 3. MALLEABLE-IRON TIE-PLATE AT RAIL JOINTS ON THE OHIO RIVER BRIDGE; PITTSBURGH & LAKE ERIE RY.

each of these points the accumulated expansion in the bridge amounts to 4 or 5 ins. While the expansion of the bridge is taken care of at one or two places between any two fixed points, the rails take care of their expansion at each rail joint between the same points. It follows, therefore, that there will be considerable motion between the rails and the tie-plates (which are in effect a part of the bridge floor).

At the rail joints, special tie-plates are used, with the spikes set entirely clear of the rails and so far apart as to be clear also of the splice bars (Fig. 3). Near the joints, therefore, the rails are held to the tie-plates only by their own weight and stiffness. This design has worked very satisfactorily since it was put in service in May, 1910. These bridge tie-plates are of malleable iron; they weigh 8.62 lbs. for the ordinary plates and 11.63 lbs. for the joint plates. The screw spikes used with the bridge tie-plates are shown in Fig. 4.

The anti-creeping devices mentioned above, are shown in Fig. 5. They consist of wide-flanged splice bars bolted to the rails and secured to the ties by screw spikes. They are attached to the rails at the fixed points of the bridge on the masonry and at about 30 or 40 ft. from the abutment on the shore side (in the direction of traffic). Over the channel span the fixed points are 769 ft. apart. Between these points the rails were laid with great care so as to provide the proper amount of expansion for the temperature at that time. The expansion corresponds to tight joints at 120° F. and maximum open joint at 20° below zero. The standard splice joint is designed to take care of a movement corresponding to a change of 140° in temperature in rails 33 ft. long.

It will be seen that on this bridge the bridge expansion movements are entirely independent of the rails. Consequently, no special expansion joints are used, such as are commonly employed on long-span bridges where the rails are attached more or less rigidly to the ties and floor system of the structure.

THE COAL PRODUCTION OF INDIANA in the year 1910 was 14,834,259 short tons, exceeding any previous annual output for this State. The coal produced came from 20 different counties, with Vigo Co. in the lead. Owen Co. appeared for the first time as a coal producer, with an output of nearly 16,000 tons. Approximately 57% of Indiana's total production was mined by machines. The total number of machines in use was 631, of which 391 were of the chain-breast pattern.

Annual Convention of the Wood Preservers' Association.

The seventh annual convention was held at the Auditorium Hotel, Chicago, Jan. 17 to 19. At the first session, resolutions were adopted expressing the regrets of the association in the loss of its distinguished member, the late Octave Chanute.

Two papers dealt with the depth of penetration to be expected with the different amounts of preservative usually specified. Mr. R. L. Allardyce (International Creosoting & Construction Co., Texarkana, Tex.) referred more particularly to the creosoting of southern pine by the full cell method. With piles, the penetration in sap or soft wood might be as follows: ¾-in. to 2½ ins.

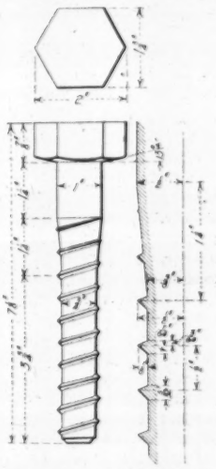


Fig. 4. Screw-Spikes Used on the Ohio River Bridge.

for 10 to 12 lbs. per cu. ft., 1½ to 3 ins. for 14 to 16 lbs., 3½ to 4 ins. for 20 lbs., and from 4½ ins. to complete penetration with 22 to 24 lbs. per cu. ft. In heart wood, the penetration would be less. With the zinc-chloride or burnettizing process for ties of loblolly pine, a treatment of 20 lbs. per cu. ft. should penetrate to within 1½ ins. of the center of the tie. The pressure should be not less than 100 lbs. per sq. in. in any case.

Mr. David Allerton (Kettle River Co.) pointed out that the penetration depends largely upon the dimensions and surface area of the timber; piles have the least surface in proportion to volume, bridge and trestle timbers rank next, and planks and boards rank highest. To get an equal penetration, the quantity of preservative must be increased with the surface area per cu. ft. The character and strength of the preservative, the character of the wood and the way in which the wood is cut all affect the results. With creosote oil of 1.03 to 1.06 specific gravity, an average penetration of 1½ ins. would be obtained with 10 lbs. per cu. ft. for piles and 12 lbs. for ties. He considered that the best plan would be for the customer to specify the depth of penetration required and then pay for the oil used to obtain this.

A paper by Mr. F. J. Angier (Kettle River Co.) outlined some of the results obtained in this country by the use of treated ties, and discussed the question of tie records. An abstract of this latter part of the paper will be published later. The use of dating nails was stated to be a very unreliable system for basing records of life of ties, and representatives of three or four railways spoke of unsatisfactory experience in this direction.

Two papers dealt with certain features of timber treating plants. Mr. R. W. Yarborough (National Lumber & Creosoting Co.) discussed the question of bare and clothed retorts, and estimated a considerable saving in fuel consumption by the use of a heat-insulating cover. However, this will not be economical if the steel shell is leaky and requires continual calking to keep it tight. In his experience, the covering of a retort (using cottonseed hulls for the purpose) eliminated trouble due to a shortage in boiler capacity. With the clothing applied, radiation was stopped, steam could be shut off for 30 mins. without loss of temperature in the retort, and there was a fuel saving of $5 to $6 per day. The advantages are especially great for plants in the northern climates. He suggested the use of a cheap covering made of sawdust mixed with starch to make it a coherent mass; this would be applied to a thickness of 2 ins., held in place by a wrapping of poultry wire, and covered with a jacket of lathing or sheet iron.

Mr. Angier stated that at the Galesburg plant of the C., B. & Q. Ry. a clothing of sawdust and asbestos is used. Another member said that the cost of asbestos covering would be 15 to 25 cts. per sq. ft., and while it would be economical to use this on the cylinder, it would not pay to use it on the working tanks and storage tanks. For these, all exhaust steam should be delivered to heating coils, being supplemented if necessary by live steam admitted through a reducing valve.

A short paper by Mr. Andrew Gibson (Northern Pacific Ry.) outlined some of the special difficulties in northern plants as compared with those in the south. These include high fuel consumption, freezing of pipes, blocking of yard tracks by snow and ice, the more refractory character of northern timbers, the long haul on the preservative material, and the labor problem. Mr. Angier remarked that the plant at Galesburg, Ill., sometimes shut down for two or three days on account of snow.

In treating hewed and sawed ties at the same plant, the two kinds should not be mixed in one charge of the cylinder, even if they have had the same degree of seasoning. This was the opinion stated in a paper by Mr. H. J. Whitmore. It is generally recognized that timbers of different kinds and of different degrees of seasoning should not be treated in the same

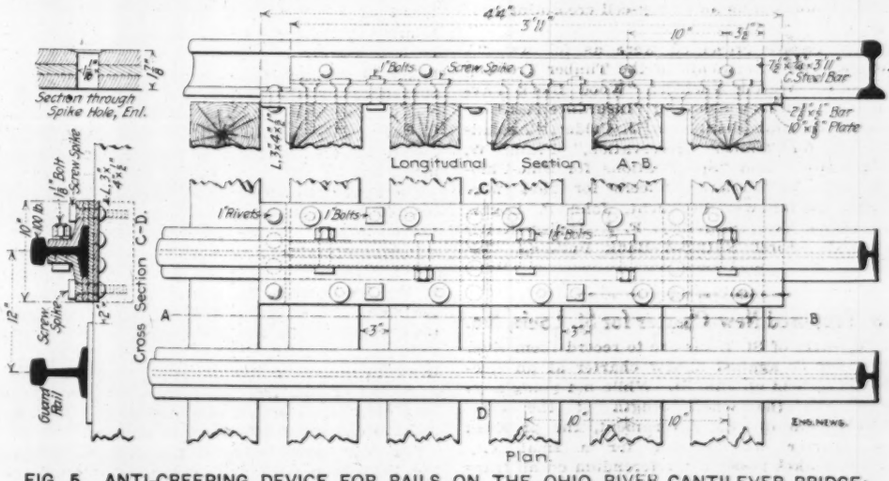


FIG. 5. ANTI-CREEPING DEVICE FOR RAILS ON THE OHIO RIVER CANTILEVER BRIDGE; PITTSBURGH & LAKE ERIE RY.

charge, but there was some difference of opinion as to the separation of hewed and sawed ties. One member thought the aim should be to separate heart wood and sap wood. Mr. Angier remarked that where a charge is made up of sawed ties the ties must be separated by sticks or slats so as to allow free access of the treating fluid. This is not necessary where sawed and hewed ties are mixed. An objection urged against this was the difficulty of making proper measurement of the quantity of timber, but to this it was replied that owing to variations in actual ties an arbitrary allowance of 120 cu. ft. is made for each tram load of ties. A paper by Mr. W. F. Goltra also discussed the possibility of grouping timbers for treatment. Resolutions were adopted by the Association in favor of this sorting and grouping timbers of different species and characteristics.

The so-called open-cell process, in which a certain proportion of the creosote injected is sought to be withdrawn from the treated timber by a subsequent vacuum treatment, was discussed at the meeting in 1910. As a result of this some tests were made during the past year by Mr. C. D. Chanute (O. Chanute & Co.) to determine what percentage of creosote oil can be withdrawn from the wood in this way. The tests were made in a cylinder holding three ties. After full treatment under 100 lbs. pressure the ties were removed and weighed, and the oil dripping from them was collected and weighed (the tie being set in a metal trough). They were then returned to the cylinder, heated to the same temperature as when under pressure, and then subjected to a 25-in. vacuum for one hour. They were then again weighed. The percentage of oil extracted by the vacuum ranged as shown in the table, and coincided very closely with the results of experiments made by Mr. Chanute 15 years ago.

EXTRACTION OF CREOSOTE BY VACUUM.

Wood.	Per cent. extracted.	Wood.	Per cent. extracted.
Red oak.....	11.1 & 11.6	Beech	12.2
Black oak.....	7.1	Poplar	6.7
Sycamore	8.9 & 9.2	Rock elm	9.3
Lob. pine.....	5.4 to 13.8	Red gum.....	15.6

In another paper presented it was suggested that the empty-cell or open-cell process is a mistake, and is likely to give disappointing results. In the discussion of a paper on the use of asphaltic oils, also, Mr. Allerton suggested that with such oils in combination with creosote oil a full-cell treatment could be given which would be as economical as an empty-cell creosoting process.

Other papers presented were as follows: "A Review of Developments in the Timber Treating Industry," Walter Buehler; "Wood Block Paving," Herman Von Schrenk; "Insurance Rates on Timber Treating Plants," R. J. Calder; "Asphaltic Oils for Timber Preservation," Frank W. Cherrington," and "Specifications for Zinc-Chloride," C. M. Taylor. Officers for 1911 were elected as follows: President, John P. Logan, Texarkana, Tex.; Secretary, F. J. Angier, Kettle River Co., First National Bank Building, Chicago.

The Proposed New Charter for St. Louis, Mo.

The voters of St. Louis are to record themselves either for or against a new charter at an election to be held on Jan. 31. While not going anything like the whole length of the commission plan of city government, the proposed new charter does provide for a small city council, makes possible a referendum on all franchise grants and provides for the recall of any elected officer. It also embodies the short-ballot principle, not alone in reducing the number of members composing the city council, but also in providing for only four additional officers, namely, a mayor, comptroller, president of the board of assessors and collector. Quite unlike the charters under the commission plan, the powers of the mayor and the city council are largely separated, although there is not the full line of division which characterizes the recent amendments to the Boston charter. The provisions of the proposed charter as regards the control of public works (given below) will be of particular interest to engineers.

If approved by popular vote at the coming election, the new charter will go into full effect in April, 1913. This provision appears to have been made to allow existing city officials to serve out their terms. Seven councilmen will be elected in April, 1911, and all the rest of the elective offices will be filled in April, 1913.

In place of the present house of delegates, or city council, elected from the 28 wards of the city, the new charter provides for a council of 15 members, one to be elected as president, all chosen at large, instead of wards, for terms of four years. Salaries are fixed at $1,800 per year for the ordinary members and $2,400 per year for the president. A reasonable allowance for necessary expenses in connection with public business is provided. Whenever any member is not present to answer his name at the roll-call at the opening of a session, a deduction of $10 from his salary will be made.

The council by a two-thirds vote may negative any veto of the mayor. It may also by two-thirds vote remove the mayor for "misdemeanor in office, for grave misconduct showing unfitness for public duty, or for permanent disability." The council also has some other powers, either alone or in conjunction with the mayor, which tend to rob him of the fullest executive control.

Notwithstanding these limitations, the mayor under the new charter would have much fuller control of all executive matters than at present. While the powers of the mayor under the new charter would be increased in some respects, particularly in that his appointments are not subject to confirmation by the council, yet in other respects his powers are curtailed. This curtailment comes in part through the reduction of the number of appointive offices to be filled directly by the mayor from sixty to thirty, in round numbers. Perhaps most sweeping is the taking away from the mayor of the power to approve or disapprove of some 1,535 subordinates in the different city departments. This latter change comes about through the fact that under the new charter the heads of the different departments will appoint their own subordinates, subject to civil service.

The salaries of the leading executive heads of the city seem to be fixed on a liberal basis. The mayor is to have $10,000 a year, the comptroller not less than $8,000 and the president of the board of assessors not less than $5,000. The salaries of the other executive officers appear to be left entirely to the city council. It may be noted in passing that the comptroller may be suspended by the mayor and removed by the council for cause, and that he is to have a seat in the council and a right to take part in the debate on any question relating to his department, but he will not have the right to vote.

The appointive offices to be filled by the mayor include five members of a board of public improvements, a health commissioner and three members of a board of health, a city counselor, a commissioner of supplies, a treasurer, a chief of the fire department, a head of the police department "when permitted to do so by law" (now appointed by the governor, if we remember rightly), a register, a marshal, three police justices, members of the hospital board, a commissioner of charities and corrections, two members of a civil service commission and trustees to have charge of a bequest to the city.

The only qualifications for appointive officers are that they shall have been citizens of the United States and of the city of St. Louis for two years prior to their appointment (except for the provisions noted below) and that they shall not be interested in any contract of the city. Any elective office may be filled by a person who has not been a citizen of St. Louis for two years, provided the city council so ordains by a vote of the majority of all the members, and for a cause stated in the ordinance. Any officer appointed by the mayor may be removed by him without trial, but the mayor must state the cause of the removal in writing if the officer to be removed so demands. The mayor is made the final arbiter, on appeal, as to "all questions of difference between officers of the city affecting their relative powers and duties under the charter and ordinances," except as noted below under the board of public improvements.

Of the five members of the board of public improvements, at least three "shall have technical training and experience." This board, which in general controls all public works and services, except those coming under the departments of fire, police, hospital, and charities and corrections, is divided into six departments: (1) engineering and construction, (2) street, (3) water, (4) building, (5) parks and public places and (6) public utilities. The engineering and construction department is to prepare all plans and specifications for all engineering, construction and reconstruction work, and to superintend construction and reconstruction, make surveys, etc. The other departments under the board of public improvements are entrusted with the supervision of the maintenance of the works or services indicated by their titles. All six of these departments are required by the charter to co-operate with each other, and the charter also provides that the employees and assistants in any department may be detailed to another department by the board, and that "all questions as to distribution of powers between the departments under the charter and ordinances shall be settled by the board, and its determination shall be final."

The department of health is under the general supervision and control of a health commissioner. The board of health contemplated by the charter seems to be nothing more than a board of appeal from orders of the commissioner for abating nuisances, and the board would have no jurisdiction even in such cases where, in the judgment of the commissioner, the existence of the nuisance was plain and the nuisance constituted a danger to the public health.

The commissioner of supplies is to "purchase all articles needed by the city in its several departments." Purchases are to be made by bids, except where the commissioner decides an emergency exists, or where the amount of purchase is less than $100, but there should be no division of purchases so as to evade the $100 limit. Whenever a standard has been adopted, as described below, then any supplies purchased must conform with the standard.

Regarding the board of standardization, we quote from the proposed charter as follows, including also one or two additional clauses of interest regarding the purchase of supplies:

> There shall be a board of standardization, consisting of a member of the board of public improvements, assigned to that duty by the board, the comptroller and the supply commissioner. This board shall classify and standardize all supplies, as far as possible. The comptroller shall be charged with the duty of inspecting and receipting for all supplies. The council shall provide, by ordinance, not inconsistent with charter regulations, for the purchase of supplies, and may establish warehouses for storing them.

The civil service commission provided for by the proposed charter is to consist of three members. Of these, two are to be appointed by the mayor for terms of four years, each at a salary of not less than $1,200. The third member is to be selected by the board of public improvements, and is to receive no compensation "as a member of the commission," but is "to serve at its pleasure." The members of the commission appointed by the mayor "may be removed by a majority of the members-elect of the council." When the mayor appoints a member, "the appointee shall be from that one of the two political parties casting the largest vote at the last preceding national election to which the other member appointed by the mayor does not belong."

The exempt list includes officers of the city council, chiefs of departments, one secretary, deputy or assistant, one cashier and one stenographer for each of the officers in the exempt service who are provided by ordinance with subordinates; also, lawyers, doctors and nurses.

The awarding of contracts, as distinct from the purchase of supplies, already mentioned, is vested in the board of public improvements. The charter states that the council is "to have no power directly to contract" in behalf of the city.

t except in cases of emergency work the board public improvements must prepare and sub- it to the council an ordinance, with estimates, uthorizing contract work. Contracts must be t to the lowest responsible bidder who has not efaulted on previous contracts.

The granting of franchises, and the general ontrol over public utilities as to "rates, quality f service and methods of conduct and opera- ion," is vested in the city council, including also he power of purchasing public utilities; but no ranchise grant is to go into effect until within hree months after it has been signed by the ayor, and if within that time 15% of the regis- ered voters of the city request a referendum, hen the franchise grant must be submitted to opular approval. Any company receiving fran- hise grants

any public utility shall keep such reports of its finances and operations as may be prescribed by ordi- nance, and the city may, at any time, examine its records and accounts.

The department of public utilities is to super- vise "all public utilities operated by individuals or private corporations," but

Any public utility acquired or constructed by the city shall be placed under the charge of such department as the board of public improvements as the board may, from time to time, direct, unless upon the recommendation of the board, a distinct department under the board is pro- vided therefor by the council.

The public-service commission already existing under the present charter is to be continued for two years, unless the ordinance which created it is repealed by the city council before that time, and while the old commission remains in exist- ence none of the powers vested in it are to be transferred to the board of public improvements.

The charter provides for the establishment of a "Public Printery" to be under the control of the register and to be entrusted with the duty of printing "a municipal paper to be designated 'City Journal.'" All elections in various branches of the city government are to be reported in this "Journal" and many of the most important, such as proceedings of the city council, within 48 hours of the time of the proceedings.

The recall provision of the charter provides, first, that "any elected city officer may be re- moved by the qualified voters of the city, and a successor elected" on the filing of a proper peti- tion with the board of election commissioners at least ten days prior to any November state election. Such a petition must be signed by at least 25% of the qualified registered voters en- titled to vote at the election in question. On proper filing of such a petition, the official bal- lots shall contain this proposition:

Shall there be an election for (stating title of office) to succeed (stating the name of the incumbent) at the next municipal election, with the words "Yes" and "No" at the right of the question, and the voter desiring the removal of such officer shall scratch the word "No" and the voter opposing the removal of such officer shall scratch the word "Yes."

The charter further provides that

if a majority of the qualified voters of said city, voting at said November election, shall vote for the removal of such officer, he shall stand removed as of the date when his successor shall be elected and qualified. If such majority do not vote for removal, such officer shall not be affected in his tenure of office by said proceedings. If removed, the unexpired term of his office shall be filled at the next municipal election.

A section of the proposed charter relating to public-library service for city officials.

The board of directors of the St. Louis Public Library shall provide in its libraries, as far as practicable, books and papers relating to municipal affairs, and supply to any officer of the city, upon his request, such informa- tion therefrom, as may be necessary and proper to aid such officer in the performance of his official duties.

Finally, we may note that the proposed charter is subject to future amendments when properly drawn and submitted separately to popular vote.

The proposed charter was drawn by a "Board of Freeholders," as provided by law. In case the proposed charter is approved on Jan. 31, it be- comes effective within 60 days without any action by the city legislature, provided it is properly certified by a majority of the Board of Freeholders and the mayor, and copies of it are filed with the secretary of state and the city register.

Mr. Frederick W. Sehman was chairman and Mr. Samuel B. McPheeters was secretary of the Board of Freeholders which drafted the charter.

Annual Meeting of the American Society of Civil Engineers.

The 58th annual meeting of the American So- ciety of Civil Engineers was held at the So- ciety's house, 220 West 57th St., New York City, Jan. 18 and 19, with supplementary meetings on Jan. 20 and 21 devoted to the discussion of road construction and maintenance.

The usual good record of attendance was maintained. The main features of the meeting were the annual business session on the morning of Jan. 18, visits to the Brooklyn Navy Yard and the plant of the Keuffel & Esser Co. at Hoboken, N. J., on the afternoon of Jan. 18; an all-day excursion to the works of the Bethlehem Steel Co., at Bethelehem, Pa., on Jan. 19; a re- ception to the incoming President on the even- ing of Jan. 18 and an informal smoker on the evening of Jan 19.

OFFICERS.—The following officers were elected for the ensuing year:

President, Mordecai T. Endicott, Civil Engi- neer, U. S. N., Rear Admiral (retired).

Vice-Presidents: Alfred P. Boller (New York) and Charles L. Strobel (Chicago, Ill.).

New Members of the Board of Directors (term expries January, 1914): George C. Clarke (New York); H. G. Stott (New York); Jonathan P. Snow (Boston, Mass.); Robert Ridgway (New York); L. W. Rundlett (St. Paul, Minn); W. H. Courtenay (Louisville, Ky.).

Members of the Nominating Committee: O. E. Hovey (New York); Frederick H. Fay (Boston); C. J. Tilden (Ann Arbor, Mich.); Thomas H. Johnson (Pittsburg, Pa.); E. E. Wall (St. Louis, Mo.); M. J. Caples (Johnson City, Tenn.); N. B. Kellogg (San Francisco, Cal.).

Mr. Don J. Whittemore, Past Pres. Am. Soc. C. E., was elected one of the Honorary Members of the Society.

Business Session.

The business session was devoted mainly to the reports of the officers and of the various committees.

The report of the Board of Direction showed that the total membership of the Society in all grades is now 5,797, a gross increase during the year of 836 and a net increase of 505, the largest growth on record. Of this total 2,767 are Mem- bers and 2,084 Associate Members. Out of 706 applications for admission to the Society during the year, 609 were elected. During the year there were 52 deaths in the Society's member- ship, 35 members were dropped from the rolls and 17 resigned.

The total receipts of the Society for the year were $127,708, of which about $105,000 was ex- pended in meeting the running expenses of the Society, including interest on the mortgage for $135,000 on the Society's house; $10,000 was ap- plied toward paying off the mortgage and about $17,000 was added to the reserve fund. The Society's total assets above all liabilities are valued at about $540,000.

COMMITTEE REPORTS.—None of the com- mittees reported much more than progress, and all of the reports were accepted by the meeting.

The Committee on Uniform Tests of Cement re- ported that during the past year the Chief of En- gineers, U. S. Army, had signified his intention of appointing a commission of officers to revise the U. S. Army Standard specifications for ce- ment, which are now about the only specifica- tions now in use in this country which differ materially from those adopted by the Society. The Committee also presented recommendations for a compression test of cement.

The Committee on Steel Columns and Struts reported that it had made arrangements with the U. S. Bureau of Standards whereby that Bureau is to test, at governmental expense, a number of columns with various shapes of section.

The Committees on Bituminous Materials for Road Construction, on Concrete and Reinforced Concrete and on Engineering Education, each re- ported progress.

DUES EXEMPTION TO OLD MEMBERS.—The following amendment to the constitution was presented at the meeting:

Corporate Members and Associates who have reached the age of 70 years, and who have paid dues as such for 25 years, shall be exempt from further dues. Corporate Members and Associates who have paid dues as such for 35 years shall be exempt from further dues.

This provoked a certain amount of opposition, vigorously led by Past-President Desmond Fitz Gerald, who considered that the effect of the amendment was to "lay on the shelf" the older members of the Society. It was explained, how- ever, that the intention was toward honoring rather than disparaging these older men, and that there were no provisions whatsoever where- by any one would be relieved of his franchise in the Society or his importance as an active member. The amendment was then adopted by the meeting and will be submitted to a letter ballot of the Society for final approval.

PRIZES.—The Secretary announced that for the year ending July, 1910, prizes had been awarded as follows: The Norman Medal to Mr. C. E. Grunsky, M. Am. Soc. C. E., for his paper entitled "The Sewer System of San Francisco, and a Solution of the Storm-Water Flow Prob- lem"; the Thomas Fitch Rowland Prize to Mr. John H. Gregory, M. Am. Soc. C. E., for his paper entitled "The Improved Water and Sew- age Works of Columbus, O." As there was no paper presented by a Junior during the past year the Collingwood Prize for Juniors was not awarded.

LICENSING OF ENGINEERS.—At the annual convention of the Society at Chicago last June, a specially appointed committee presented a re- port "On Licensing of Civil Engineers" which in- cluded a resumé of the status of licensing laws in the various States, certain recommendations in regard to the proper provisions of such laws and a final recommendation that the Board of Direction "take up this matter with the proper authorities from time to time as may be deemed expedient, and . . . urge the enactment of State laws governing the practice of civil engineering. . . ." This committee report was accepted by the convention. Acting upon the recommenda- tions of this committee the Board of Direction at the annual meeting brought in a set of resolu- tions, which read as follows:

WHEREAS: There are national societies of engineers in the United States, membership in which can only be secured after rigid examination of the fitness of appli- cants to practice as engineers; and

WHEREAS: The public has ample protection if they will employ only those who have thus demonstrated their ability; be it

RESOLVED: That the Board of Direction of the American Society of Civil Engineers does not deem it necessary or desirable that civil engineers should be licensed in any State; and be it further

RESOLVED: That if, notwithstanding this, the Legis- lature of any State deems the passage of a statute cover- ing the practice of civil engineering desirable for the protection of the public, the accompanying draft of such a statute, which has been prepared by the Board as embodying proper requirements for that purpose, is re- commended.

These resolutions were followed by the sug- gested statute which, together with other mat- ter regarding this same subject, is printed in an article entitled "The Licensing of Engineers" on another page of this issue. We have also com- mented editorially upon the subject.

A very animated discussion followed the read- ing of these resolutions, marked especially by the extreme complication of the parliamentary pro- cedure. Out of the mass of motions and amend- ments which came before the meeting, only four of which were recognized by the chair, two were finally evolved which were passed. These were, first, that the Resolutions as presented by the Board of Direction be accepted by the meeting, and second, that it was the sense of the meeting that the first clause of the resolutions proper be endorsed. This last motion, it will be noted, put the meeting on record as being opposed to the adoption of any licensing law in any state.

DISCUSSION ON ROADS.—The report of this discussion is published on p. 114 of this issue under the title "Discussions on Road Construc- tion and Maintenance, etc."

The discussion was carried on on both Jan. 20 and 21, and was quite largely attended by engi- neers and contractors interested in the design and construction of roads.

Discussions on Road Construction and Maintenance; American Society of Civil Engineers.

At close of the annual meeting of the American Society of Civil Engineers held in New York City on Jan. 18 and 19, three meetings were held for discussion of the general topics "Road Construction and Maintenance." By general consent the subject was narrowed to the use of oils, and bitumens on macadam. The general procedure was to have the discussion opened, on some particular sub-topic, by some one or more men actively engaged in work closely related to the particular questions involved. Ten minutes was allowed, or rather was supposed to have been allowed, these principal speakers, and then opportunity for five-minute discussions was given to all.

PRELIMINARY STUDIES.—The first session, on Jan. 20, took up (1) "Preliminary Investigations," (2) "Relative Value of Three Methods of Carrying on Work: (a) That in which both labor and material are furnished by the contractor. (b) That in which the material is supplied by the party of the first part, and the labor by the contractor. (c) That in which both the labor and material are supplied by the party of the first part," and (3) "Systems of Maintenance."

The argument of Mr. Logan W. Page, Director, U. S. Office of Public Roads, who opened the discussion on "Preliminary Investigations," was that only a start toward successful roads, for modern conditions, has been made. He had found lack of knowledge widespread and he suggested that all road builders include in their experiments study of the complete chemical and physical properties of the materials used. He advocated the early publication of such complete information, including the effect of local conditions. Incidentally he expressed the opinion that standardized specifications could not be prepared for bituminous binders.

Mr. W. W. Crosby dwelt on the necessity of knowing well the traffic and peculiar local conditions, before any rational attempt could be made to remedy the troubles met with. He had found too little adequate information about the more important kinds of road work, which would permit most intelligent selection to best fit circumstances.

Prof. A. H. Blanchard of Brown University, Deputy Engineer, Rhode Island Board of Public Roads, believed that a certain degree of success with one method or another had often led many engineers to try to apply that single method to all sorts of roads and under conditions which had prevented full success. He felt that sufficient information was now available so that the advisability of ordinary or bituminous macadam, of surface treated water-bound macadam, or of city-type pavements like stone, brick, and asphalt could be determined. In making a traffic census, he maintained there should be a distinction between pleasure and commercial vehicles, horse-drawn and motor vehicles; weights, number of horses, speeds, grades, etc., were held proper for inclusion.

Mr. Harold Parker, Member of the Massachusetts Highway Commission, called attention to the necessity of ascertaining the amount and character of the traffic which would come upon a road after its improvement. In many cases he was sure the most economical and most satisfactory roadway would be determined by prospective rather than actual traffic.

CONTRACTS.—The second topic, "Relative Value of Three Methods of Carrying on Work: (a) That in which both labor and material are furnished by the contractor; (b) That in which the material is supplied by the party of the first part and the labor by the contractor; (c) That in which both the labor and material are supplied by the party of the first part," was first presented by Mr. Harold Parker. He held that the topic was not susceptible of much discussion as it was evident that if work had to be done within certain appropriations or at fixed cost the first arrangement would be preferable. Where certain brands of materials had to be used or where the party of the first part desired complete control over the materials the second method, he believed, would prove most satisfactory and economical. The third arrangement he would employ where special skill was required which the contractor could not be expected to acquire or where the work could not be clearly defined, by specifications, for estimating.

Mr. Henry B. Drown, Assistant Engineer, Rhode Island Board of Public Roads, discussed the topic with respect to bituminous-bound roads only. He had come to believe that the first plan was not the best because of the present general inexperience of contractors, because the available materials were not uniform or interchangeable, and because of need of changing the specifications after beginning work. He had found the yardage of road construction increased by the first plan but at the expense of quality. The third plan, he held was favorable to the party of the first part only when a trained force was necessary and the choice of materials was very broad, as for road maintenance. New construction could be undertaken, by this plan, only by very large municipalities where much work was to be done.

Mr. Joseph W. Hunter, Pennsylvania Highway Department, cited a case where over 8% had been saved by the third plan on a $15,000 bid by the first plan. Mr. Paul D. Sargent, Highway Commissioner of Maine, had used all three and had found one job, (2 miles of gravel road) that when the third plan had been used, 50% better work had been secured at 50% contract prices.

Mr. F. E. Ellis, of Melrose, Mass., said that contractors would be pleased to have gravel and local stone furnished, as it was common experience that when several contractors, after the same job, approached the local owners for estimates on supplies then prices went soaring.

Mr. W. W. Crosby said that in doing work under the third plan, engineers were apt to deceive themselves by omitting consideration of overhead charges like rental, maintenance and depreciation on machinery. Mr. James Owen, County Engineer, Essex County, N. J., called attention to the need of adding a fourth class of plans—one by which the materials are bought by contract and the labor is furnished by the party of the first part.

Mr. Samuel Whinery, Consulting Engineer, New York City, held that the second scheme was better than using broad specifications, especially for asphalt compounds. It was often advantageous to purchase materials, by contract, at opportune times and store them until work started.

MAINTENANCE.—"Systems of Maintenance" was the third topic discussed. Mr. Hubert K. Bishop, Chief, Bureau of Maintenance, New York Highway Commission, Albany, N. Y., opened by describing the system of the New York State Highway commission. They had assumed the burden of 2,000 miles of roads constructed under local-aid plans in 54 counties and 500 towns. Some roads were ten years old and in bad condition. No funds were available for organized maintenance. The state was divided into six divisions, each having from 380 to 400 miles of highway. A division engineer was in charge of each division and under him a Superintendent of Repairs. Each division was split into from five to seven sections. Various sub-sections or patrols were established so as to have about five miles of road. On trunk lines the distances were made shorter and longer on back-country stretches. Patrolmen were selected for experience in roadwork and required to provide themselves with a horse and tools. They were given work for nine months at $3 to $3.50 per day. The patrolmen's work was largely preventive, not going beyond very minor repairs. Construction work has been entirely divorced from such maintenance. Patrolmen make daily post-card reports of movements and work. An inspector makes irregular trips about a section and reports daily by post cards. The Superintendents report daily to the commission at Albany where the amount and nature of the maintenance is recorded. The cost of patroling amounts to about $150 per mile per year, including supervision, or $106 without supervision costs.

Mr. Frank J. Chappell, Engineer for Mercer County, N. J., described his use of oils, having 40 to 45% petroleum asphalts, at a cost of cts. per sq. yd., including screenings, for ordinary sprinkling methods. By the use of a high pressure sprinkler, the cost had been reduced to 4.2 cts. total. Also a blown residue oil, 5 cts. per gal., had been used to form a trial mat. In using this latter the road had been swept and sprinkled (washed), about ½ gal. per sq. yd. had been applied at 152°F. This chilled on the wet surface. Sand had been spread on and rolled and the road immediately thrown open. Uniform application of oil had been found necessary to prevent waves. A life of two years for such a mat had been secured. The cost had been about 9 cts. per sq. yd.

Mr. G. C. Wright, of Rochester, N. Y., briefly described the use of road surfacing in prepared cubes as developed in Monroe County, N. Y. The cubes can be made of stone or gravel concrete, petrified shale, bituminous concrete, etc., as described in Engineering News, March 3, 1910. Samples had been tested by placing in boxes on a planer bed and loading with an iron wheel whose journals were fastened to the head.

DUST PREVENTION.—In the afternoon of the first day the topic "The Use of Water, Calcium Chloride, Light Oils, etc. as Dust Palliatives" was taken up. The subject was opened by Mr. S. Whinery, of New York. In his remarks Mr. Whinery excluded all considerations of road preservation except as they might be incidental to the object of dust laying. He maintained that water had been longest used as a dust layer but was still the least developed of any. Accurate and extended studies on the effects and costs of using water had not been made or at least had not been published. No other municipal process had received less care and supervision. He asked for a careful study and fair trial of water, and believed that it would prove the most beneficial of all methods. Exclusive of the cost of the water itself, the cost of sprinkling was generally taken to be from 1 to 3 cts. per sq. yd. per season. The amount of water varied from 10 to 40 gals., with probably 40 as an average. This, added to 2 cts. per sq. yd. for applying, made an average total cost of 2½ cts. per season. Sprinkling should be done according to specifications which demand a moist condition and a cleaning of the streets to remove mud. Mr. Whinery took 3 cts. per sq. yd. per season as the basis for comparison with other methods. He said that Boston was the only place where calcium chloride had been largely used. There 408,811 sq. yds. had been treated at a cost of 4.7 cts. per sq. yd., compared with water sprinkling at 2.5 cts. The interval between sprinklings was usually 27 days, but more frequent treatment was needed in some places, especially inland. He believed that the use of calcium chloride was less effective and more expensive than ordinary water. He admitted that lighter oils would suppress dust, but claimed that more data were necessary for complete comparisons. His idea was that oil was a nuisance at first and ineffective after a while, so that water sprinkling was often resorted to. He also believed that oil would promote raveling by tending to make the pavement impervious to moisture. He proposed the use of power pumps and high-speed motor-driven tank wagons for keeping the dust down in country districts.

Mr. Herbert C. Poor, of the Barrett Mfg. Co., Boston, Mass., described the use of light refined coal tar as a dust layer and a preservative of the road surface. The scheme consisted of sweeping the road and applying the light tar, ½-gal. per sq. yd., from a pressure sprinkler or by any convenient hand method; after a few hours, grits were sprinkled on. Where a street could be closed for 24 hours, no grits were necessary. The cost was from 3 to 5 cts. per sq. yd., including all materials and labor. In the fall a second treatment of ¼-gal. per sq. yd. was desirable to carry the road through the winter. The surface secured was claimed to be hard and non-absorbent and to allow of cleaning.

Mr. Joseph L. Weeks, of Baltimore, described

e use of oil emulsions as dust layers in that ty. The oil was received in tank cars and distributed over each road from once a week to nce in two or three weeks. The cost had been und to be about 2 cts. per sq. yd. per season.

Mr. H. K. Bishop called attention to the use f calcium chloride by the New York Highway ommission. The salt was received in the dry ranular form, costing about $13 per ton. Good ccess had been secured with three applications r year; the first one of 1 lb. per sq. yd., a cond of ¾-lb. and a third of ½-lb. The cost mounted to from $125 to $150 per mile, which ncluded a low labor charge. The effect of the alt had been to keep the road moist and to elp preserve the traffic cushion. In Washington, D. C., calcium chloride had been used as in New York with good results on residential streets. It was applied more frequently depending on the weather. Satisfaction was believed to be more likely in a moist climate than in an inland city.

PRESERVATION OF MACADAM.—The topic "Surface Treatment with Tars, Heavy Oils, etc." was introduced by a discussion communicated by Mr. C. W. Ross, Street Commissioner of Newton, Mass. He stated that he believed macadam was still the best pavement for present conditions, if only specially treated. He had used oils and lighter compounds in several ways, such as (1) applying cold asphaltic oil to a finished road to form a mat which was continually ironed down and consolidated by automobiles; (2) applying heavier oils hot to the upper course of stone to give a solid bituminous coat; (3) a semi-solid surfacing mixed before laying, and (4) by scattering on the road sand mixed with some asphaltic compound but without rolling.

Mr. Prevost Hubbard, Assistant Chemist, U. S. Office of Public Roads, Washington, D. C., stated that the character of the traffic was the most important factor in successful application of road preservatives except character of oil. Horse-drawn traffic had been found to damage the surface mat which could be built by motor vehicles. It was necessary to know the volume of traffic in bad weather, and to know its division into motor and horse-drawn classes. He cited cases leading to the opinion that an equal proportion of horse-drawn and motor vehicles was necessary if the shoe-marks of horses on the traffic cushion were to be ironed down by automobiles.

Mr. Arthur W. Dean, Chief Engineer of the Massachusetts Highway Commission, said that 225 miles under his jurisdiction had been treated with bituminous binders, mostly by hot applications. The cost in 1907 was 7 2/3 cts. per sq. yd., average, for roadways 15 ft. wide. Patching had been resorted to by painting the depressions and filling with fine stone. Some of the roads oiled in 1908 were still good with very little patching. On some roads oiling had been useless on account of heavy ice-wagons with narrow tires, and in these cases the surface had to be entirely removed.

Mr. W. W. Crosby called attention to the use of sulphite waste liquor at a cost of 7 cts. per sq. yd. It was found that the material served fairly well, but disappeared in a year.

Prof. A. H. Blanchard presented a series of topics on which more light was needed. These were (1) relative advantages of pressure and gravity sprinklers; (2) amount of penetration secured; (3) relative amounts of sand, gravel or stone chips needed as cover; (4) desirability of no cover; (5) the economics of drying out damp macadam surface before oiling; (6) size of stone in road as related to economy of surface treatments; (7) slipperiness; (8) effect of non-skidding devices of automobile-tires, and (9) cost data for series of annual applications of a given material to the same road.

BITUMINOUS BINDERS.—The third session considered tar and asphalt binders incorporated in the body of the road during construction. In presenting the topic "The Use of Bituminous Materials by Penetration Methods," Mr. W. W. Crosby reported that local conditions in Maryland required penetration methods almost exclusively. The macadam was built as usual up to the point of applying binder. In some cases sand had been used with the stone to partly fill the voids. Up to 5 gals. per sq. yd. of pitch had then been sprinkled on and in 1908 water-gas tar at 6 cts. per gal. was found successful. Some 20 different binding materials had been tried on a road stretching out into the country from Baltimore. Here the average cost of the work had proved to be 20 to 34 cts. per sq. yd. for stone for reinforcing, and 26 to 70 cts. for binding, including cost of heating, applying, chips, rental of tools, etc. In 1910 the maintenance charges on these strips varied from 1.6 to 40 cts.

Mr. Alexander F. Armstrong, Chief Bureau of Research, New York Highway Commission, reported that in two years the New York Highway Commission had supervised construction of 673 miles of bituminous-bound macadam, made by the penetration method, and only two miles made by mixing methods. On the whole these roads had proved satisfactory. One had been a complete failure and others had failed over portions or in patches. Success had been attributed to full compliance with the intent of the specifications. Mr. Armstrong believed that in cases of failure about the country, the binder had been too indiscriminately blamed, without careful consideration of factors like drainage, foundation, quality of stone, cleanness, workmanship, climatic conditions, etc., which had equal importance. He believed that pockets of finer material in the stone were responsible for an unequal absorption which led to bleeding in summer and cracking in winter. Accurate cost data from 78 miles of road, built in 1909, showed the average cost in excess of water-bound macadam to be 24 cts.—made up of 5 cts. for labor, 17 cts. for material, 1 ct. for equipment charges and 1 ct. for engineering. About 1.6 gals. per sq. yd. of binder was used. At present mixing methods had been developed to be nearly as cheap as penetration, if more than three miles of road were to be built so that machinery could economically be used.

Mr. James C. Wonders, Highway Commissioner of Ohio, reported uniformly good results with penetration work. He believed that, when the cost of a road approached $10,000 per mile, a brick road would prove more economical and that a brick road, as put down in Ohio, should wear 50 years.

Mr. Robert A. Meeker, Highway Commissioner of New Jersey, reported trouble from fluxing asphalts with paraffine-base oils. He had also found that dust on stone affected the binder more than a little moisture, for bitumen would adhere to cold, moist stone if cleaned with gasolene. He laid extreme stress on the benefits he had secured from complete consolidation of the broken stone before applying the binder. The bottom courses for such roads in New Jersey were always filled with sand or smaller stone.

Mr. Clifford Richardson, of New York City, suggested that the penetration method of applying a binder might prove to provide a reservoir of bitumen in the later years of the life of a roadway. On account of the smaller excess of binder in a road built by the mixing method, it might be necessary to apply a seal coat each year.

"Mixing Methods" were first discussed by Prof. A. H. Blanchard, who reported that the most economical trunk roads built in Rhode Island, since 1906, had used a tar binder in the preparation of stone for the body—and an asphalt for the seal coat. The cost, during the season from June to September, had been found to be from 25 to 35 cts. per sq. yd. in excess of ordinary macadam. For traffic which was 90% motor cars and light horse-drawn vehicles, the flush coat was not necessary and the road could be put down from 15 to 25 cts. in excess of ordinary macadam. He attributed failures to one or more of several causes, such as poor binder, poor stone, improper size of stone, dirty stone, too heavy three-wheel rollers, accumulation of roadside dust before applying binder, over compacting before binding, and incompetent supervision.

Mr. F. C. Pillsbury, Division Engineer, Massachusetts Highway Commission, made the declaration, rather surprising to most present, that it is possible to put down a bituminous-bound roadway, made by the mixing method, which will sustain the heaviest horse-drawn traffic satisfactorily; for medium traffic of horse-drawn vehicles and motor cars the penetration method suffices. In very many cases, he maintained, such bituminous-bound surfacing might take the place of brick, stone and wood.

Mr. W. H. Connell, Assistant Commissioner of Public Works, Borough of the Bronx, New York City, described the test strips recently built under his supervision on White Plains Road. This work was noted in Engineering News, Jan. 19, p. 66.

Mr. Paul D. Sargent reported that the Maine Highway Department had completed only six jobs of road construction by the mixing method. In general, the cost had been 50% in excess of the cost of building ordinary macadam in any particular case. The best results had been secured using local stone (limestone and granite). No success had come from heating the stone and no trouble had been found from using cold stone.

Mr. James Owen, County Engineer of Essex County, N. J., urged the great importance of engineers considering the economics of their road work—taking thought about where the money was coming from and the effect of durability on distributed cost. He stated that the public had been educated to a type of construction costing from 50 to 60 cts. per sq. yd., while present methods under discussion called for from $1 to $1.50.

The Licensing of Engineers; Action of the American Society of Civil Engineers.

Outside of matters of purely technical interest, the question of licensing engineers is undoubtedly one of the most important of those to-day before the engineering profession. In a number of States bills have been introduced in the legislatures embodying certain rules and regulations to govern the practice of engineering in those states. In a few instances these bills have been enacted, although the proportion to the total number of States in the Union is very small.

One of the most prominent of these proposed laws was that known as the Raldiris Bill, presented to the Legislature of the State of New York last year.* This bill was objectionable to many prominent engineers in the State and was vigorously fought by a number of them. The fight reached the American Society of Civil Engineers last Spring, with the result that a resolution was introduced at one of the regular meetings recommending that the Society investigate the bill, and if it should be found defective that a committee be appointed to confer with the legislature regarding it. Such a committee was appointed and partially as a result of its activities, Mr. Raldiris withdrew his bill with the promise that the bill would be held over until the present session.

On April 6 of last year the Board of Direction of the Society adopted the following resolution:

> Resolved, That it is the sense of the Board that it is the duty of the American Society of Civil Engineers to use its influence in the proper formulation of all legislation by the general government, or by any of the States of the Union, which affects the practice of engineers; and the Board recommends the appointment by the Society of a committee whose duty it shall be to formulate the general lines on which such legislation should be based, and that said Committee be requested to report at the next annual convention.

The committee appointed under this resolution reported at the annual convention of the Society in Chicago last June. Its report was reprinted in full in Engineering News, June 30, 1910, p. 761. This report gave a brief resumé of such laws governing engineering practice as are now in force in several of the States and noted the other States in whose legislatures bills have been introduced but have not been enacted. The report further states that "there is an unmistakable tendency towards legislation regulating the practice of civil engineers, and that it is important that there should be uniformity in all States at least in so far as the requirements for admission

*Engineering News, Feb. 24, 1910, p. 233; March 24, 1910, p. 343; March 31, 1910, p. 387; April 7, 1910, p. 411; April 14, 1910, p. 438; May 5, 1910, p. 529.

to practice are concerned." After a few suggestive paragraphs as to what such a law should contain, the committee finally recommended

that the Board of Directors be empowered in behalf of the Society to take up this matter with the proper authorities from time to time as may be deemed expedient, and to urge the enactment of State laws governing the practice of civil engineers in general conformity with the suggestions of this report, and further, that the Board appoint from the membership of the Society a committee of three in each State to co-operate with the Board in this matter, and to act under its direction.

In the discussion that followed the presentation of this report, several arguments were advanced which are repeated in nearly every discussion of the subject. We therefore set them down briefly here.

1. The committee recommended that corporate membership in the American Society of Civil Engineers shall entitle the holders thereof to licenses. It is obvious that there are a number of engineers practicing as "mechanical engineers," "electrical engineers," etc., who are not members of the American Society of Civil Engineers but who are members of other engineering societies of high standing and who should be admitted to practice under their qualifications as members of such societies in the same measure as members of the American Society of Civil Engineers.

2. The Society is asking that the State shall step in and regulate the practice of civil engineering. It is well known that the Society has repeatedly refused to take up the consideration of preparing and adopting a code of ethics which shall express its views with reference to the very many matters with which a licensing law must necessarily deal. It would therefore seem that it would be appropriate that the Society first adopt some code of ethics or rules regulating the practice of the profession before asking the State to interfere in behalf of its members.

3. It is evident that many engineers, both those in the employ of large corporations and in independent practice, find it necessary to travel from one State to another in the pursuit of their profession. Unless all the laws are uniform, with interchangeable license provisions, therefore, the adoption of any of the laws by the States will work great hardship to such engineers.

4. Behind many of the movements for licensing engineers there is quite evident a sentiment similar to that which inspires trade unions; that is, there are a number of men in the profession who feel that their services are not justly rewarded and that their only safeguard is in some legalized closed circle into which only certain qualified men can come. They feel that if there is a State-authorized body of men known as civil engineers, they can demand certain things from their clients or employers which they cannot hope to secure so long as the profession is an open one.

5. It is a fact that in a great number of States there are being introduced laws to govern the practice of engineering. It therefore behooves the better element of the profession to get together and to suggest to these legislatures such laws as, in the opinion of this better element, will be most desirable. This should be done regardless of the opinion of these engineers as to the desirability or undesirability of such laws.

As noted in our account of the annual meeting of the American Society of Civil Engineers on another page of this issue, the Board of Direction of the Society, acting on its resolution of April 6, 1910, noted above, which resolution was approved by the annual convention, presented at the annual meeting last week the following resolutions. These resolutions were approved by vote of the meeting. They read as follows:

Whereas: There are national societies of engineers in the United States, membership in which can only be secured after rigid examination of the fitness of applicants to practice as engineers; and

Whereas: The public has ample protection if they will employ only those who have thus demonstrated their ability; be it

Resolved: That the Board of Direction of the American Society of Civil Engineers does not deem it necessary or desirable that civil engineers should be licensed in any State; and be it further

Resolved: That if, notwithstanding this, the Legislature of any State deems the passage of a statute covering the practice of civil engineering desirable for the protection of the public, the accompanying draft of such a statute, which has been prepared by the Board as embodying proper requirements for that purpose, is recommended.

AN ACT TO PROVIDE FOR THE LICENSING OF CIVIL ENGINEERS.

The people of the State of....., represented in Senate and Assembly, do enact as follows:

SECTION 1.—After May 1st, 19.., no person shall practice civil engineering within the meaning of this Act in the State of ..... unless authorized by license from the State Board of Engineering Examiners, as required by this Act.

SECTION 2.—Practice of Civil Engineering.—Civil engineering, within the meaning of this Act, is the practice of any branch of the profession of engineering other than military. Said profession embraces the design and supervision of the construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary and drainage works, of works for the development, transmission and application of power, and of electrical, mechanical, mining, industrial, hydraulic, municipal, sanitary, structural and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation.

The enumeration of any public or private utilities or works in this section shall not be held to exclude from said profession the design and supervision of other public or private utilities or works which require experience and like technical knowledge.

SECTION 3.—State Board of Engineering Examiners.—A State Board of Engineering Examiners of nine (9) members shall be appointed by the Governor, each of whom, except as hereinafter provided, shall hold office for six (6) years fom May 1st of the year in which he is appointed. In constituting the first Board to be appointed under this Act, the Governor shall designate three (3) members to serve for two (2) years from May 1st, 19..; three (3) members to serve for four (4) years from May 1st, 19.., and three (3) members to serve for the full term of six (6) years from May 1st, 19...

Thereafter, the Governor shall appoint biennially three (3) members for the full term of six (6) years, to fill the vacancies caused by expiration of term of office, and may, at any time, fill vacancies in the Board for the unexpired term caused by death, resignation, or removal from office. The Governor may remove any member of the Board of Examiners for misconduct, incapacity, or neglect of duty.

Each member of the Board of Engineering Examiners shall be a professional civil engineer at least thirty-five (35) years of age, shall have had at least ten (10) years' active practice, be of recognized standing in the profession, and be licensed under this Act. He shall have been a resident of the State of ..... for one (1) year immediately preceding his appointment.

Wherever the words "the Board" are used in this Act they mean the State Board of Engineering Examiners provided for by this section.

SECTION 4.—Certificate of Appointment, Oath, Powers.—Every member of the Board shall receive a certificate of appointment from the Governor, and before beginning his term of office shall file with the Secretary of State the constitutional oath of office. Each member of the first Board shall receive a license under this Act from said Board when organized.

The Board, or any committee thereof, shall be entitled to the counsel and services of the Attorney General, shall have the power to compel the attendance of witnesses, and may take testimony and proofs concerning all matters within its jurisdiction.

The Board shall adopt a seal which shall be affixed to all licenses granted, and may make all by-laws and rules, not inconsistent with law, needed in performing its duty; but no by-law or rule by which more than a majority vote is required for any specified action by the Board shall be amended, suspended, or repealed by a smaller vote than that required for action thereunder.

SECTION 5.—Expenses.—The fees derived from the operation of this Act shall be paid into the State Treasury, and the Legislature shall annually appropriate amounts sufficient to pay all proper expenses incurred pursuant to this Act.

Warrants for the payment of expenses incurred shall be issued by the Comptroller, and paid by the State Treasurer upon presentation of vouchers regularly drawn and approved by the President and Secretary of the Board.

On or before the first day of February in each year, the Board shall submit to the Legislature a written report of its proceedings for the preceding year, and shall file with the Secretary of State a copy of said report together with a complete statement of the receipts and expenditures of the Board, attested by the affidavits of the President and Secretary, and a complete register of those licensed to practice civil engineering under this Act, with their addresses and the dates of their licenses.

SECTION 6.—Officers, Meetings, Quorum, Committees.—The Board shall biennially elect from its members a President and a Vice-President for the ensuing biennial term.

The Board shall appoint a secretary, who shall not a member of the Board, but who shall have the sa qualification as herein required for members ther He shall hold office during the pleasure of Board, and shall receive an annual compensation .....dollars. He shall give a bond with sureties to approved by the Board conditioned for the faithful p formance of his duties and for the accounting payment over, of all moneys received by him.

The secretary shall keep a record on file in the off of the Board of all licenses granted, and shall rece and account for all fees derived from the operation this Act. He shall perform all other duties which in from time to time be assigned to him by the Board.

The Board shall hold at least six (6) stated meetin in each year. Special meetings may be called at oth times by the President or by three (3) members of th Board. At least ten (10) days' notice of all meetin shall be given.

At any meetings of the Board three (3) members sha constitute a quorum.

SECTION 7.—Admissions to Examination.—The Boa shall admit to examination any candidate who pay fee of ..... dollars and submits evidence, verified b oath and satisfactory to the Board that he

(1) is more than twenty-one (21) years of age.

(2) is of good character,

(3) has been engaged actively in civil engineeri work, as assistant or otherwise, for at least six (6) years, and has had charge of engineering work for at least one (1) year,

(4) or, is a graduate from a school of engineering of recognized reputation, and has been engaged actively in civil engineering work, as assistant or otherwise, for at least four (4) years, and has had charge of engineering work for at least one (1) year.

SECTION 8.—Licenses Without Examinations.—The Board shall issue a license, upon due application therefor, and the payment of a fee of ..... dollars, within one (1) year after this Act takes effect, to any candidate furnishing evidence satisfactory to said Board, that the candidate is qualified for admission to examination as prescribed in Section 7 hereof and has practiced civil engineering for an additional period of not less than four (4) years immediately preceding. After the expiration of said period of one (1) year, the Board shall issue licenses only as hereinafter provided.

SECTION 9.—Examinations.—Examinations for license shall be given at stated or called meetings of the Board, which shall be held at various places within the State, at the selection of the Board. The scope of the examinations and the methods of procedure shall be prescribed by the Board. The examinations may be either oral or written, or partly oral and partly written, but shall be as nearly uniform as is reasonably possible in each specialty covered. As soon as practicable after the close of each examination a certificate shall be filed in the office of the Secretary of the Board, signed by the members conducting such examination. Said certificate shall show the action of the Board upon each application, whereupon the Secretary of the Board shall notify each applicant of the result of his examination. If a candidate fails on first examination, he may, after an interval of not less than six (6) months, nor more than one (1) year, have a second examination without additional fee.

SECTION 10.—Licenses.—Upon the payment of an additional fee of ..... dollars any applicant who has been certified as having passed the prescribed examination shall receive a license to practice, signed by the President and Secretary of the Board, under its seal, which license shall state that the applicant has given satisfactory evidence of fitness as to age, character, education and training, and all other matters required by this Act, and that, after examination, he has been found properly qualified to practice.

The Board shall, from time to time, examine the requirements for licenses in other States, and shall register those in which, in the judgment of said Board, standards not lower than those provided by this Act are maintained. Upon the presentation, by a resident of a State so registered, to the Secretary of said Board, of satisfactory evidence that he holds a license issued by proper authority in such State, or upon the presentation by a civil engineer resident in a State not so registered, of satisfactory evidence that he is qualified as prescribed in Section 7 hereof and has practiced civil engineering for an additional period of not less than four (4) years immediately preceding his application, accompanied in either case by a fee of ..... dollars, the Secretary shall issue to him a license to practice civil engineering in the state of ....., whereupon the person to whom said license is issued shall be entitled to all the rights and privileges conferred by a license issued after examination by the Board.

Before any license is issued, it shall be numbered and recorded in a book kept for that purpose in the office of the Board, and its number shall be noted on the license. This register shall be open to public inspection and in all legal proceedings the same or a transcript of any part thereof, certified by the Secretary of the Board under its seal, shall be entitled to admission in evidence.

No unlicensed person shall qualify as a witness before

any State or municipal court as an expert in civil engineering.

No map, plan, or drawing required by law to be certified or approved by a civil engineer shall be accepted or filed by State or municipal authority, unless the certification or approval is executed by a person duly licensed in accordance with the provisions of this Act.

SECTION 11.—Revocation of License, Annulment of Registry.—The Board shall have power at any and all times to inquire into the identity of any person claiming to be a licensed civil engineer, and, after due service of notice in writing, require him to prove, to the satisfaction of said Board, that he is the person licensed to practice civil engineering under the license by virtue of which he claims the privilege of this Act. When the Board finds that a person claiming to be a civil engineer, licensed under this Act, is not in fact the person to whom the license was issued, the findings of the Board shall be reduced to writing and shall be filed in the office of the Board. Said certificate shall be *prima facie* evidence that the person mentioned therein is falsely impersonating a practitioner or a former practitioner of a like or different name.

The Board may revoke the license of a practitioner and annul his registration, if said practitioner has been guilty of any fraud or deceit in his practice, or has been guilty of any fraud or deceit by which he was granted a license to practice, or has been convicted of crime.

When charges are preferred, the Board shall designate six (6) of its number, as a committee to hear and determine said charges. A time and place for the hearing shall be fixed by the said committee as soon as convenient, and a copy of the charges, together with a notice of the time and place when they will be heard and determined, shall be served upon the accused or his counsel at least ten (10) days before the date actually fixed for said hearing. Where personal service, or service upon counsel, cannot be effected, and such fact is certified on oath by any person duly authorized to make legal service, the Board shall cause to be published for at least seven (7) times, for at least twenty (20) days prior to the hearing, in two daily papers in the section of the State in which the accused was last known to practice, a notice to the effect that at a definite time and place a hearing will be had on the charges against the accused upon an application to revoke his license. At said hearing the accused shall have the right to cross-examine witnesses and to produce witnesses in his defence, and to appear personally or by counsel. The said committee shall make a written report of its findings and recommendations, and the same shall be submitted forthwith to the Board. If the said committee shall by a two-thirds vote recommend that the license of the accused be revoked and his registration annulled, the Board may thereupon, in its discretion, revoke said license and annul said registration. If the Board shall revoke said license, its action shall be recorded in the same manner as licenses are registered, and the name of the accused shall be stricken from the list of licensed civil engineers.

Section 12.—Certificate Presumptive Evidence.—Unauthorized Registration and License Prohibited.—Every unrevoked certificate and endorsement of registery, made as provided in this Act, shall be presumptive evidence in all courts and places that the person named therein is legally registered.

No diploma, or license conferred on a person, other than by the Board, or its Secretary, shall be lawful authority for the practice of civil engineering within the meaning of this Act.

Section 13.—Penalties and Their Collection.—Any person who, not being then lawfully authorized to practice civil engineering within this State according to the provisions of this Act, shall attempt to practice, or shall so practice, and any such person who shall, in connection with his name, use any designation tending to imply or designate him as a practitioner of civil engineering within the meaning of this Act, and any person who shall have violated the provisions of this Act, shall be deemed guilty of a misdemeanor. Any person presenting, or attempting to file as his own, the license of another, or who shall give either false or forged evidence of any kind to the Board, or to any member thereof, in connection with an application for a license to practice civil engineering, or who shall practice civil engineering under a false or assumed name, or who shall falsely personate another practitioner of a like or different name, shall for each offense be punished by a fine of not less than $100 nor more than $500, or by imprisonment for three (3) months, or by both such fine and imprisonment.

SECTION 14.—This Act shall not apply to engineers working for the United States Government; nor to any engineer employed as an assistant to an engineer licensed to practice civil engineering in the State of.....; nor to any engineer coming from another State and employed by the State or any municipality, corporation, firm, or individual therein, until a sufficient time shall have elapsed to permit the licensing of such person.

SECTION 15.—This Act shall take effect on the first day of May, 19..

Report of the Commission Appointed to Investigate the Collapse of the Henke Reinforced Concrete Building, Cleveland, O.

As noted in our issue of Dec. 8, 1910, p. 636, at 7 p. m. on Nov. 22, 1910, a four-story reinforced-concrete building being erected for the Henke Furniture Co., on the corner of Lorain Ave. and West 30th St., Cleveland, Ohio, suddenly collapsed, throwing one of the walls over on a two-story frame building next door, and so crushing the structure as to cause the death of four of its occupants and the serious injury of seven others.

Immediately after the failure, Mr. F. G. Hogen, the Director of Public Safety of the City, requested the Builders' Exchange, the Cleveland Engineering Society and the Cleveland Chapter, American Institute of Architects, each to appoint two members to serve on a board of inquiry which should thoroughly investigate the accident and report upon it to the Director. That Commission, composed of H. B. Briggs and V. E. Thebaud, of the Institute of Architects; J. C. Skeel and J. R. Gloyd, of the Builders' Exchange, and W. O. Henderer and B. R. Leffler, of the Cleveland Engineering Society, has been conducting a very painstaking inquest and has just made its report. From that report we reproduce below the important items.

REPORT.

Your Commission bases its report on information gathered in nine visits to the ruins, on testimony taken at 17 public sessions at which 86 witnesses were examined, at five sessions before the coroner where 22 witnesses were examined, on the results of explorations of the ruins made at the expense of the city, and in 28 private sessions.

DESCRIPTION OF BUILDING.

The building,* which replaced a building destroyed by fire May 12, 1910, extended along Lorain Ave. 103 ft., along West 30th St. 90 ft., and contained a basement and four stories. The original drawings called for a wall-bearing building of mill construction, but alternative tenders were received for reinforced-concrete construction, and the contract was awarded for the latter, the type adopted being a wall-bearing structure with the conventional reinforced-concrete column, girder, rib and tile floor, with slab cast monolithic with girder.

Portions of the basement walls, the smoke stack, the west wall to level of the third floor and the show window lintel girders of the burned building were retained in the new construction. The new footings of walls and columns were of plain concrete.

The Lorain Ave. and West 30th St. fronts of the building were faced with sand stone and shale brick. The inside of exterior walls was faced with new hollow brick and all other parts up to the fourth floor were built of brick taken from the burned building. The fourth story and parapet walls were built of new brick.

The building was to be used as a furniture store and was owned by H. A. Henke. The architects were Searles, Hirsh & Gavin, and the contractor was The Forest City Construction Co.

The contract was signed July 25, 1910, included all trades except plumbing, heating and electrical work; provided for completion by Nov. 10, 1910, and contained a bonus and damage clause of $10 per day for completion before or after the latter date. Work was commenced July 28, 1910, and the building permit issued Aug. 11, 1910.

COLLAPSE OF BUILDING.

From the evidence submitted it appears that the collapse occurred at about 7.15 p. m., Tuesday, Nov. 22, 1910, and that the time elapsing between the initial failure and the wrecking of the building did not exceed one minute. The collapse was complete and practically instantaneous.

While no fatalities occurred in the Henke Building, the upper portion of the west wall fell on and crushed the adjoining building occupied as a store and living apartment, resulting in loss of life and injury to the occupants.

It is the belief of your Commission that the initial failure was due to the premature removal of forms and supports in the third story, as from the testimony of eye witnesses and other evidence, the initial failure presumably occurred (1) in the east section of the fourth floor, or (2) in one or more of the third-story columns, or (3) a combination of both.

The weather reports show very unfavorable conditions during the construction of the third and fourth story columns and the fourth floor and roof slabs, and in view of the short time the third story columns and fourth floor had been in place, the concrete had not developed sufficient strength to carry the roof and roof forms as a dead load when these third-story forms and supports were removed.

PRIMARY CAUSES OF COLLAPSE.

In fixing the cause of and the responsibility for the collapse of the Henke Building, your Commission believes it well to name the parties engaged in the design and construction of the building, and to consider the relation and responsibility of each party to the collapse. The parties are: the architects, the contractor, the owner, and the Department of Buildings of the City of Cleveland.

In considering each party it is well to remember that the negligence of any one may be a contributory cause to the collapse. The following data cover, in the opinion of your Commission, the primary causes of the collapse.

ARCHITECTS.—It is the belief of your Commission that the architects were negligent in the following respects:

(1) Although the evidence shows that the architects advised and requested the owner to place a special reinforced concrete inspector on the work during the progress of construction, they did not specifically call the owner's attention to Section 473 of the Building Code, which by mandatory requirement provides that the owner shall place such an inspector on the work.

(2) The architects did not name in the application for the building permit a special inspector—as required by Section 473—who was to be continually on the work during the placing of concrete and steel. Assuming the architects to be experts in building construction and acquainted with the provisions of the Building Code, they should have caused the owner to name an acceptable special inspector and cooperated with the Department of Buildings in the enforcement of this section.

(3) The architects did not give adequate consideration to the removal of the forms of the concrete work. They evidently gave little attention to weather conditions from Oct. 22 to Nov. 22, inclusive, when, according to the United States Weather Reports, there were 16 days in which the temperature was 32° or below—with a minimum of 25°; and during which time there were only four clear days with 15 days of rain or snow. Under these weather conditions more than ordinary precaution should have been taken in the removal of forms.

(4) The architects did not give adequate consideration to the sand used in the building. The specifications called for washed sand, while unwashed sand, not of uniform quality, was used.

(5) The architects did not exercise proper judgment in advising the owner in regard to the rapidity with which the work could be safely prosecuted. The testimony shows that the work was hurried from the beginning.

In view of the foregoing points of neglected duty it is the opinion of your Commission that the architectural supervision was deficient.

CONTRACTOR.—It is the opinion of your Commission that the contractor upon signing the contract assumed the responsibility of executing the work in accordance with the plans and specifications, and any deviation from them should have been made only upon order of the architects; but that the contractor should not be held responsible for errors of design.

It is the belief of your Commission, based upon the evidence submitted and investigation of ruins, that the contractor was negligent in the following particulars:

(1) The foremen employed on the building were ignorant of the requirements of the drawings and specifications; were ignorant of the proper methods of handling concrete for reinforced-concrete work, did not know what kind of cement was being used; did not exercise proper care in the measurement and mixing of concrete aggregate and the placing of reinforcing steel; allowed brick work and erection of forms to proceed upon green concrete; and conducted the work generally in a loose, slipshod and hurried manner.

(2) The reinforcing steel was carelessly placed in ribs, girders and columns, and no provision was made to ensure steel being in its proper position after concrete had been poured. The girder rods did not extend the proper distance beyond the column centers; girder shear rods and column hoops were improperly or insecurely placed; sleeves used for splicing column rods were of improper sizes, carelessly placed and not filled with mortar.

(3) The structural members of concrete were not of proper sizes, concrete was of poor quality and not properly placed, as shown by the following particulars:

(a) Whereas 4-in. slab ribs were called for, many 3-in. ribs were found.

(b) Several girders and slab ribs were found to be badly honeycombed.

(c) Broken specimens of the concrete showed it was not of uniform quality.

(d) Due to work being done on green concrete the bond between concrete and steel was broken.

(e) Header tile were not filled as specified, causing loss of mortar in the concrete of adjacent girders.

(f) In some cases sawdust was found in bases of columns.

(4) The sand used was, in many cases, of inferior quality, contained loam and clay and did not meet the specification requirements for washed sand.

(5) The cement delivered at the building was apparently 20% less in amount than the amount necessary to properly construct the work in accordance with the specifications.

*See Eng. News, Dec. 8, 1910, p. 637.

(6) The forms were usually removed without the consent of the architects in violation of the specification requirements.

In the east side of the third story, forms, supporting the fourth floor, were removed in 16 days after the pouring of concrete, and the floor reshored. The removal of these forms, in this short time, was, considering the weather conditions during the month of November, extremely dangerous. This time would hardly have been sufficient under favorable weather conditions.

These forms were removed without the consent of and contrary to the instructions of the architects. Although braces ordinarily used in reshoring might have been sufficient under ordinary conditions, under the above noted conditions, the original forms and shores should have been left intact a much longer time; as, by removing the same, the slightest settlement in the floor would have tended to break the bond between the steel and concrete, thereby destroying the efficiency of the reinforced concrete.

It is the opinion of your Commission that the removal or changing of these forms and shores was the one primary cause of the collapse.

OWNER.—In the opinion of your Commission the owner was negligent in that he did not employ a special reinforced concrete inspector on the building as advised by the architects.

DEPARTMENT OF BUILDINGS.—Section 473 of the Building Code provides in part as follows:

When any concrete wall or armored, reinforced or trussed concrete is used in construction, the owner shall provide for the inspection of cement and inerts, as required by the Inspector of Buildings; he shall also provide a special inspector of the work who shall be satisfactory at all times to the Inspector of Buildings, and who shall be on the work continually during the mixing and the placing of concrete and steel. Such special inspector shall make daily reports to the Inspector of Buildings on the progress of the work.

Before issuing a permit for the work, the owner shall name in writing, the special inspector, and such special inspector shall pass such examination as may be required by the Inspector of Buildings to determine his competency.

It is the opinion of your Commission that this provision of the Code was not complied with in any particular. This section is mandatory and in view of the extreme importance of close, careful supervision and inspection of this class of construction, and in view of the fact that the cost of such service is at the expense of the owner, we do not believe the evidence shows any excuse whatever for the non-enforcement of this requirement, and we believe the Inspector of Buildings was negligent in that he did not insist on the owner having a competent special reinforced concrete inspector on the building.

The evidence shows that the Inspector of Buildings, Engineer of Construction and the Masonry Inspector in that district were at the building enough times to have ascertained whether such special inspector was on the work or not; to say nothing of the fact that daily reports were not being made to the Inspector of Buildings by such special inspector.

In view of the evidence submitted and data obtained your Commission is of the opinion that the enforcement of Section 473 of the Building Code is not only practicable, but that it would be of assistance to the Inspector of Buildings in the supervision of reinforced-concrete work, especially as this assistance and service would be without expense to the city.

CONTRIBUTORY CAUSES.

The investigations of your Commission show carelessness in the design and construction of the building in a number of instances which undoubtedly contributed to the complete and instantaneous collapse of it, as indicated, in part, by the following: Effect of thrust of fourth-story arches; use of excessive number of brick bats or half bricks; use of thick mortar joints and soft brick; eccentric loading of piers supporting show window lintels; and inadequate support for south and of West 30th St. show window lintel (evidence shows that this 'support was changed during construction from a steel channel column to a brick pier).

Much of the brick mortar was poor; some of the lime was not thoroughly slaked; some of the mortar was mixed and built into walls while hot from the slaking of lime thereby destroying the value of the cement; and unwashed sand containing loam and clay was used.

EXPLOSION THEORY.—After a thorough investigation your Commission is of the opinion that the disaster was not caused by an explosion.

SETTLEMENT OF COLUMN FOOTINGS.—The testimony shows that sand had been taken from near column footings, but it is the opinion of your Commission, based upon its investigation, that the collapse was not caused by the shifting or settlement of the column footings.

REINFORCED-CONCRETE DESIGN.—From the evidence submitted your Commission is satisfied that the reinforced-concrete design was a safe one.

COMMENT.

CONCRETE CONSTRUCTION.—Your Commission finds, from its investigation, no reason to condemn the use of concrete in combination with steel for the structural parts of buildings, provided; the concrete is composed of proper materials, accurately measured and thoroughly mixed; the steel of sufficient strength and properly placed; the work installed by competent contractors and workmen; and the specifications, drawings and construction prepared and executed under the direction of competent designers and inspectors.

The report is accompanied by a number of exhibits, showing the weather data, photographs of ruins, material quantities, and the documents in connection with the construction, but not showing the details of the design. This design, we understand, comprised straight reinforcing rods in the columns and a loose rod system of reinforcement, with stirrups, in the beams.

BUILDING CODE.

The following supplementary report upon the Building Code of the city of Cleveland is of general interest:

The Commission begs to supplement its report by the following information and recommendations based upon its investigation:

The Building Code was criticized by the Inspector of Buildings in three principal particulars: (1) the multitudinous duties imposed on the Inspector; (2) the lack of sequence in the Code resulting from its many reference features; and (3) the insufficient force authorized by the Code for its administration.

The administration of the Building Code is wholly upon a mandatory basis, a provision which in general is wise and proper, but one which, in some cases, imposes unnecessary hardships upon owners and builders. The Code should be so changed, that, in cases where unreasonable requirements prevent the construction of safe and proper buildings and structures a provision should be made which will permit such buildings and structures to be erected.

Your Commission addressed a letter to over one hundred architects, engineers, contractors, owners, and others interested in building operations asking for replies upon the questions raised by the Inspector of Buildings relative to the Code, upon the Code's mandatory features and upon the advisability of licensing architects, engineers and contractors.

The replies to this letter and the investigation of your Commission show an intense interest in the questions raised and indicate that immediate steps should be taken by the city to enact such legislative measures as may be necessary to adequately meet the apparent defects in the Building Code.

Your Commission therefore begs to submit the following recommendations, respectfully asking that you give them careful consideration and, if they meet your approval, that they be referred to the City Council:

(1) That a Commission of building experts, not connected with the Department of Buildings, be created and authorized to prepare a thorough and complete codification of the Building Code.

That this Commission be requested to investigate and report to the proper department or body of the city government upon the following matters:

(a) The field and function of the Department of Buildings.

(b) The working relationship between the Department of Buildings, the Department of Police, the Department of Fire and the Board of Health, to ascertain whether these departments are working in cooperation; and to find whether there is any unnecessary overlapping of duties in these departments.

(c) The force employed in the Department of Buildings, to ascertain whether the present force is sufficient to administer the Code.

(d) The administrative and business methods of the Department of Buildings.

(e) Title X. of the Building Code, to ascertain whether it fully and adequately provides for concrete construction.

(f) The duties of the Inspector of Buildings, to ascertain whether it is practicable for him to effectively discharge these duties.

(g) The consideration of the qualifications for architects, engineers and contractors engaged in the erection of buildings and structures in the city of Cleveland.

(h) The consideration of the question as to effective enforcement of Section 241 of the Building Code which provides a penalty for violations.

(i) The consideration of any and all other matters resulting from the codification work, which will improve and make the Building Code more efficient.

(2) That a permanent Commission of building experts be created and authorized to serve in an advisory capacity to the Department of Buildings and the Board of Appeal in the determination of technical questions arising from the administration of the Code; in the consideration of new forms of construction or of materials used in the same; and in all technical and administrative matters upon which the Department or Board may ask or require advice.

Descriptions of the Panama Canal Work in Recent Volumes of Engineering News.

In view of numerous requests and of the approaching excursion to Panama by members of the American Society of Civil Engineers, we have compiled the following list of the principal articles on the Panama Canal that have appeared in recent volumes of Engineering News.

Graphical illustration of the cross-section of Culebra Cut. Dec. 14, 1905, p. 632.

Report of Board of Consulting Engineers and Comments thereon. Feb. 22, 1906, p. 203.

President Roosevelt's special message on. (Condensed.) Dec. 20, 1906, p. 663.

Biographical sketches of Col. Goethals and Maj. Gaillard and Sibert. Mar. 7, 1907, p. 273.

Extracts from Annual Report of the Isthmian Canal Commission. Nov. 28, 1907, p. 567.

Pay of engineers and privileges allowed. Feb. 6, 1908, p. 151.

Extracts from the Annual Report of the Isthmian Canal Commission. Dec. 3, 1908, p. 601.

Report on the Foundations and Construction of the Gatun Dam. Dec. 24, 1908, p. 722.

Design of the lock gates and of an emergency dam. Dec. 31, 1908, p. 747.

Report of Board of Engineers on work. Biographical sketches of members of the board. Feb. 25, 1909, p. 211.

Reasons why the lock plan for the canal is preferable to the sea-level plan. Feb. 25, 1909, p. 216; Mar. 4, 1909, p. 245.

Address of Col. Goethals on the Panama Canal before the Manufacturers' Association of Chicago, Ill. Mar. 18, 1909, p. 303.

Concerning the Gatun Dam and earth dams in general. Apr. 1, 1909, p. 354.

The locks of the Panama Canal. July 15, 1909, p. 61.

Designs for emergency movable dams. July 22, 1909, p. 96.

Notes on the Panama Canal, past and present. By Lieut.-Col. H. F. Hodges. Sept. 30, 1909, p. 348.

Extracts from the Annual Report of the Isthmian Canal Commission. Nov. 25, 1909, p. 565.

Water supply for the canal and seepage from Gatun Lake. Feb. 24, 1910, p. 214.

Laying concrete for the Gatun Locks. Apr. 7, 1910, p. 389.

Extracts from the Annual Report of the Isthmian Canal Commission. Nov. 24, 1910, p. 555.

The principal books on the Panama Canal are: General Henry L. Abbot's "Problems of the Panama Canal," 1907; "The Panama Canal and its Makers," by Cornish, 1908 and "Four Centuries of the Panama Canal," by Johnson, 1907. Of these Gen. Abbot's deals much more fully with the engineering side than either of the others, but was written when the plans for the work were still more or less undetermined. The other two books are written in a popular style and Johnson's is chiefly concerned with the political and diplomatic history of the Canal enterprise.

Notes from Engineering Schools.

UNIVERSITY OF MICHIGAN.—A national alumni dinner will be held in New York City at the Hotel Astor, Feb. 4. The guests of honor will be William R. Day, class of 1870, of the U. S. Supreme Court, four U. S. Senators and 23 U. S. Representatives. Among members of the faculty who will preside at individual tables, the Department of Engineering is represented by Dean M. E. Cooley and Professors H. C. Ladler, Gardner S. Williams and John R. Allen. The chairman of the committee in charge is Earl D. Babst, 409 West 15th St., New York City.

RENSSELAER POLYTECHNIC INSTITUTE.—A reunion of the general alumni association will be held in Chicago, Ill., Feb. 2-3. On Feb. 2, a trip will be made to Gary, Ind., to inspect the steel works. In the evening, the alumni will attend the Blackstone Theatre, after which a smoker will be given at one of the clubs. On Feb. 3, the new Chicago & North Western Ry. passenger terminal will be visited and afterward the Union Stock Yards. In the evening a banquet will be served at the Blackstone Hotel. The secretary of the Alumni Association is Charles A. Bradley, 617-145 La Salle St., Chicago, Ill.

A ROUNDHOUSE FIRE at Marshalltown, Iowa, Jan. 15, destroyed the 22-stall house of the Iowa Central Ry., and twelve locomotives. Five other locomotives in the house were saved.

A FREIGHT LOCOMOTIVE'S BOILER EXPLODED on the New York Central & Hudson River R. R., near Wales Station, 20 miles east of Buffalo, N. Y., Jan. 18. Three trainmen were killed.

A POWDER MILL EXPLOSION wrecked the canning mill of the Du Pont Powder Co., at Wapwallopen, Pa., Jan. 16. One man was burned to death.

A NEW FAST TRAIN RECORD for the run from Washington to New York City was made Jan. 23 by a special train chartered by J. Pierpont Morgan. The distance over the Pennsylvania R. R., on which the run was made, is 226.8 miles and the time was 3 hours 55½ minutes. The net running time, subtracting seven minutes for delays caused by switching and by changing locomotives for the run through the Hudson River tunnel, was 3 hours 48½ minutes. From West Philadelphia to the new Pennsylvania R. R. station in New York, a distance of 90.5 miles, the time was 78.5 minutes plus three minutes for changing locomotives. This part of the run then was made at the average rate of 69 mi. per hr.

AN AEROPLANE FLIGHT from land to ship was made by Eugene B. Ely, near San Francisco, on Jan. 18. The experiment was carried on under the auspices of the Navy Department with the cruiser "Pennsylvania." A wooden platform, some 130 ft. long by 50 ft. wide, was built over the after deck, sloping aft. Across the platform and close to the floor were stretched weighted ropes designed to engage grapples on the aeroplane when it should alight. The flight to the ship was made about 11 a. m. The landing on the platform was made at a speed of 30 miles per hour, but there was no trouble in retarding the machine within the length of the floor. After lunch the grapples on the machine were removed; it was reversed and the flight back to land successfully completed.

A COLLISION IN WALES, at Hopkinstown, near Pontypridd, Jan. 23, wrecked a passenger train and a coal train. Eleven persons were killed.

AN EXPLOSION IN A GOLD MINE owned by the Keating Gold Mining Co., at Radersburg, Mont., Jan. 18, caused the death of six miners. Two others were injured. Reports state that a power magazine was maintained in the mine at the 200-ft. level.

A COAL-MINE EXPLOSION at Gayton, Va., Jan. 20, killed five men and injured eleven others.

LEAKING ILLUMINATING GAS from a private gas plant in the basement of a hotel at Niobara, Neb., caused an explosion and fire which destroyed the building Jan. 15. Four persons were killed and four injured. The hotel building was a three-story frame structure.

BOILER FEED-WATER REGULATORS, while securing immunity from the dangers of extreme high or low water in the boiler, have the further advantage of maintaining the feed-water temperature more nearly constant and giving a higher average temperature than is obtained with hand regulation. With an automatic regulator and a feed-pump governor, the water level can be kept within an inch of the set position even under wide fluctuations of load. The regulator feeds water to the boiler in proportion to the rate at which steam is being used. The amount of exhaust steam entering the feed-water heater is also proportional to the load on the plant. Thus the fluctuations of steam supply at the heater coincide with the fluctuations in the amount of water fed through it, and the feed temperature is maintained more nearly constant than with hand regulation of the feed water.

Charts taken with a recording thermometer were recently brought to our attention in which the average feed temperature is shown to be much steadier with the use of the automatic regulator than with hand regulation. With the automatic regulator, moreover, the average feed temperature in a 24-hour run was 5° higher than with hand regulation. The regulator used was of the Copes pattern, sold by the Northern Equipment Co., of Chicago, Ill. In the Copes regulator, the expansion of a metal tube is depended upon to close or open a valve in the feed line. The tube is connected to the boiler in such a way as to be filled either with steam or water, depending on the boiler water level. A few inches variation in water level suffices to change the contents of the whole tube, which is set on a slant. When filled with water, the tube is quickly cooled, since the radiation loss cannot then be counteracted by the entrance of fresh steam from the boiler. The contraction of the tube allows a weight to close the valve. When the tube expands, it raises the weight, and the valve is opened to admit more water to the boiler.

THE COPPER PRODUCTION of the mines in the United States in 1910 is estimated in a recent bulletin of the U. S. Geological Survey at 1,079,000,000 lbs. This is less than in 1909, but larger than in any previous year. The productions of the five leading States are estimated as follows: Arizona, about 291,000,000 lbs.; Montana, about 285,000,000 lbs.; Michigan, about 220,000,000 lbs.; Utah, about 102,000,000 lbs.; Nevada, about 64,00,000 lbs. Of these five States, Utah and Nevada alone show any substantial increase in output over that for 1909. Arizona's output remained about the same. Montana's decreased by about 10%, and Michigan's by about 3%.

THE PRODUCTION OF TUNGSTEN in the United States in 1910 was 1,824 short tons, valued at $832,992. The greatest production from any one locality came from Boulder Co., Cal., with the Atolia field in California second. This 1910 production, according to a bulletin of the U. S. Geological Survey, is believed to be the largest annual output so far made by this or any other country. The value of the output, however, is less than in 1907, when 1,640 short tons brought $890,048.

DOES TARRING ROADS CAUSE INJURY TO ADJACENT PLANTS OR TREES?—Investigation of the effect of tarred roads upon plants was recently undertaken in France by M. Ed. Griffon, a prominent road engineer, and he has presented his conclusions to the Academy of Sciences. There have been various complaints as to the hurtful action of tarred roads and sidewalks upon trees and plants. In Paris there were special complaints as to the wide avenue of the Bois de Boulogne, although the roadway there is separated from the grass plots or ornamental plants by a non-tarred way of 40 ft. width for equestrians.

M. Griffon was engaged in 1908 by the Paris authorities to investigate the effects of tarring. Tests with plants under globes or in tubes showed that the gases coming from tar, especially when they are hot, kill the cells of the vegetable tissues. But the vapors given off by the tar on roads in the open air are very much diluted. Experiments made at Paris by the author never produced any serious injury to plants. The author observed tarring operations in Paris upon different avenues and found that during the tarring no effect was noticed. In certain cases at Paris where complaint was made, plants which were set out some time after the tarring took place had suffered as much as the plants which had been exposed from the first to the fresh vapors. It appears that the action of dust may be as important as the action of vapors. The author found that dust taken from the avenue of the Bois de Boulogne and sprinkled on leaves of certain tender varieties of plants caused a burning effect that did not occur with ordinary dust. However, numerous ornamental plants, shrubbery and trees showed no injury. The author expressed himself in favor of tarring or asphalting, and considered that in view of the very slight damage to plants observed, it would be unjust to cast discredit upon a process which has such decided advantages.

WORK ON THE PANAMA LOCK GATES.—The first shipment of materials for work on the lock gates arrived on the Isthmus last week on the "St. Andrews" from Baltimore, consisting of 400 tons of equipment for handling the steel that will form the gates. This equipment includes two truss bridges, 134 ft. 6 ins. in length and 11 ft. wide, which will be constructed over the lock chambers. On these bridges will be a railroad track, on which locomotive cranes will operate in handling the steel for the gates from the material yard alongside the locks. The bridges will be so constructed that when one set of gates is finished they can be moved from their location over one set of gates to the location of other gates. The first shipment of steel for the gates is expected to leave the McClintic-Marshall shops near Pittsburg by Jan. 15 and to arrive on the Isthmus early in February.—"Canal Record," Jan. 11.

PORTLAND CEMENT PRODUCTION FOR 1910 is estimated by Mr. E. F. Burchard, the U. S. Geological Survey expert, to have reached between 73,000,000 and 75,000,000 bbls., as compared with 63,508,471 bbls. produced in 1909. This estimate is derived from partial production figures from all parts of the country, so that it should be fairly accurate. The report further says that although the average values for 1910 appear, from returns received thus far, to have been slightly higher than in 1909, prices were far from satisfactory, especially to the large manufacturers in the Lehigh Valley district and in certain of the Eastern States. The year 1911 opens with prices cut 5 to 10 cts. a barrel lower than those prevailing in 1910. The construction of several new plants has been pushed during the year, and several plants that were under construction in 1909 became producers in 1910, so that the kiln capacity remains far in advance of the demand.

ABOLITION OF GRADE CROSSINGS in Massachusetts for 20 years is summarized as follows in the annual report of the State Railroad Commission: Since the beginning of the work of abolition of grade crossings under the general law, $34,372,048 have been expended. Since the grade crossing act of 1890, the different railroad companies have expended for abolition or alteration of grade crossings the sum of $21,109,841, the Commonwealth has spent $8,809,021, the different cities and towns $4,414,995, while the sum of $39,188 has been paid from the Metropolitan Parks Loan Fund. During the year 1910, bonds for the further abolition of grade crossings were issued to the amount of $500,000. The total amount which has been authorized by general law and various special acts is $14,500,000.

THE PENNSYLVANIA RAILROAD opened to traffic at noon, Jan. 19, the outbound track over the Schuylkill River to the West Philadelphia station. This, with the new inbound track opened to service Jan. 14, increases the total number of Pennsylvania tracks in operation over the Schuylkill River to six. Formerly one inbound and one outbound track were used for trains of the Philadelphia, Baltimore & Washington R. R., and only two tracks remained for the use of all other divisions.

To widen the Schuylkill River bridge for the two additional tracks, the abutments were extended on each side. The extensions are of coarse sandstone on a foundation of concrete extending from water level to bed rock. The new tracks are carried on trusses wholly separated from the old structure. Each track constitutes a single-track deck bridge of 160-ft. span. The bridge floors are of 12-in. concrete carried on two longitudinal steel stringers, 12 ins. wide and 4 ft. apart. This concrete floor carries the track ballast and crossties. New steel viaducts will extend from the bridge to the 30th St. abutments of the West Philadelphia station to carry the tracks over the roadways along the river bank at the lower level.

Another improvement to the Broad St. station approach (Philadelphia) will be the addition of a 70-ft. turntable and a new passenger storage yard between 20th and 23d Sts. When completed, the new yard will accommodate about 50 cars, or about nine suburban trains. This new storage space and turntable so near the Broad St. station are expected to facilitate the making up of suburban trains during the rush hours, and thus combine with the two new bridge tracks to relieve congestion on the Broad St. station approach.

TESTS OF LAP-WELDED PIPE have been made recently which show a high strength in the weld. Test bars cut from the welded seam have shown a tensile strength of over 60,000 lbs. per sq. in., or fully equal to that of the body of the plate forming the pipe. A length of 24-in. pipe ¼-in. thick was tested for fatigue of the metal to see if the weld would weaken under repeated strains. The pressure was bought up to between 900 and 1,100 lbs. for nine times and the pipe showed no signs of fracture although it had bulged out 1¼ ins. in diameter. On the next application a small fracture occurred near the weld. The internal diameter was then 25¼ ins., and the stress on the metal was over 55,000 lbs. per sq. in. A length of 20-in. pipe (¼-in. thick) was crushed in a hydraulic press to the welded seam. This required a pressure of 565,000 lbs., and although the seam was badly folded it remained tight under water pressure. The pipe was made by the American Spiral Pipe Works, and was tested by R. W. Hunt & Co. Pipe of this kind, 12-in. to 72-in. diameter, is made from open-hearth flange steel of 55,000 to 65,000 lbs. tensile strength. After welding, it is heated in an annealing furnace.

A BILL TO PREVENT THE CONTAMINATION OF the Ohio River and to regulate its use as a source of public water-supply has been drafted by a committee of the Ohio River Sanitary Commission for introduction in the legislatures of West Virginia and Indiana. The committee consisted of Judge E. E. Korn, Ironton, Ohio; Dr. C. O. Probst, Secretary of Ohio State Board of Health, Columbus, Ohio, and Mr. Paul Hansen, State Sanitary Engineer of Kentucky, located for the present at Columbus, Ohio. The bill provides that no municipality, corporation, institution or person shall install or contract for the installation of a public water-supply or sewerage system or for additions to either water-supply or sewerage systems which involve changes in the source of supply, or any methods of treating the water or which involve changes in the outfalls or increased amount of sewage or changes in the method of disposal of the sewage, until complete plans and specifications for the contemplated work have been submitted to and approved by the State Board of Health. No site for a manufacturing or industrial plant which produces putrescible or other liquid waste shall be adopted "until said site is approved by the State Board of Health, or unless some method for adequately purifying such wastes, satisfactory to the State Board of Health, is to be used." It will be understood that the bill as drawn applies only to public water-supplies taken from the Ohio River, or to systems of sewerage and to industrial plants discharging into that stream. Final jurisdiction over points at issue under the bill is provided for as follows:

The finding and decision of the State Board of Health upon all matters covered by this act shall be final and conclusive, except for fraud and abuse of discretion and for such causes, an aggrieved party may have an appeal to the Court of Common Pleas of the county

where such water-works or sewer system is located; and said court shall hear said appeal and may affirm or reverse, or modify such decision. But the decision appealed from shall not be superseded by the appeal, but shall stand until reversed or modified by said court.

The penalty fixed for violation of the act is $500 or imprisonment for not longer than six months, or both. It may be well to add that the states of Ohio and Pennsylvania have already vested sanitary control of water-works and sewerage matters in their respective health departments.

Personals.

Mr. La Verne Ruddock, of Wheaton, Ill., has opened an office in that city for the general practice of engineering and surveying.

Mr. John L. Newcomb, Associate Professor of Civil Engineering at the University of Virginia, has opened an office in Charlottesville, Va., as a consulting engineer.

Mr. Paul D. Sargent, formerly State Highway Commissioner of Maine, has been appointed Assistant Director of the United States Office of Public Roads at Washington, D. C.

Mr. J. M. Macoun, of the Canadian Geological Survey, who, with a party of 14, was wrecked in a gale off Wager Inlet, Hudson Bay, last September, has arrived safely at Fort Churchill, after having been given up for lost.

Mr. William H. Edwards, Commissioner of Street Cleaning of the City of New York, has been awarded a Carnegie Hero Medal for his prompt action in saving Mayor Gaynor from a would-be assassin on Aug. 9 of last year.

Mr. John F. Galvin, President of the Automatic Axle Co., of New York, and a director in other industrial concerns, has been appointed by Mayor Gaynor a Commissioner on the Board of Water Supply of the City of New York.

Mr. Henry B. Browne, Assoc. M. Am. Soc. C. E., formerly Assistant Engineer of the State Board of Public Roads of Rhode Island, has accepted a position with Mr. Arthur H. Blanchard, M. Am. Soc. C. E., Consulting Highway Engineer of Providence, R. I.

Dr. L. P. Kinnicutt, Director of the Department of Chemistry at the Worcester Polytechnic Institute, has been granted a leave of absence for the balance of the school year. Dr. Kinnicutt has had charge of the department for 27 years, during which time he has been engaged also in private work along sanitary and analytical lines. He will, when his health permits, continue his private work.

Mr. Victor C. Alderson, President of the Colorado School of Mines, Mr. James Dalrymple, State Coal Mine Inspector, Professor John B. Ekeley of the University of Colorado, and State Geologist George have been appointed by Governor Shafroth a commission to study the coal mining industry of Colorado, with a view to the prevention of such mine accidents as that which recently occurred at Starkville.

Mr. Louis K. Rourke, M. Am. Soc. C. E., formerly Commissioner of the Street Department of Boston, Mass., has been appointed Commissioner of Public Works of the same city. This is a new position created on a plan devised by Mr. Rourke for placing Boston's Department of Public Works under one engineering head, which plan was described in Engineering News on Dec. 22, 1910. Mr. Rourke was formerly on the Panama Canal work in charge of the Culebra Cut excavation under Col. Gaillard.

Mr. Frederick R. Hutton, Past President of the American Society Mechanical Engineers, and Secretary of the society for a number of years, has been appointed Consulting Engineer of the Department of Water Supply, Gas and Electricity of the City of New York, to succeed the late George W. Birdsall, whose death is recorded elsewhere in these columns. Mr. Hutton is a graduate of Columbia University, New York City, and Professor Emeritus of Mechanical Engineering at the same institution.

Mr. Alexander E. Kâstl, M. Am. Soc. C. E., who has recently been appointed Special Deputy State Engineer of New York, in charge of the Barge Canal work, is a graduate of the University of Michigan in the class of 1885. In 1882 he was U. S. Assistant Engineer on the Mississippi River Survey, and in 1884 Assistant City Engineer of Grand Rapids, Mich. After receiving his degree in civil engineering he held many positions in railway, municipal and river and harbor work. He has been Division Engineer of the Sanitary District of Chicago, Division Engineer of the Metropolitan Water Works for the city of Boston, Mass., Chief Engineer of the Denver Union Water Co., Denver, Colo., and until his appointment as Deputy State Engineer, had been Division Engineer of the Board of Water Supply of the City of New York, of which Mr. John A. Bensel, recently elected State Engineer, was President.

Obituary.

William D. Elam, formerly Chief Engineer of the New Orleans Levee Board, died recently at his home in New Orleans, La. He was born in Baton Rouge in 1866. He received his education at Magruder Institute at Baton Rouge and at Louisiana State University. He was Chief Engineer of the Levee Board from 1898 to 1908. A widow and three young children survive him.

John O. Norbom, M. Am. Inst. M. E., of Berkeley, Cal., was killed as the result of an explosion on a ferry-boat at Berkeley on Jan. 20. It is reported that the explosion was caused by an explosive which Mr. Norbom was carrying on his person. He was 44 years old and a native of Norway, where he received an engineering education. He went to California about 20 years ago and had been interested in many mining enterprises. He leaves a widow and one son, who is a student in Berkeley.

John J. McLaughlin, M. Am. Soc. C. E., Consulting Engineer for the Borough of Queens, New York City, died at his home in Jamaica, N. Y., on Jan. 19, from an attack of grip. He had been County Engineer for Queens County for more than 20 years, during which time many miles of macadam roads were built under his direction. Since the consolidation with greater New York he had been Consulting Engineer. He was 51 years old and a graduate of New York University. A widow, six daughters and two sons survive him.

George W. Birdsall, Consulting Engineer of the Department of Water Supply, Gas and Electricity of the City of New York, died at his home in that city on Jan. 22. He entered the service of the city in 1872 and in 1875 became First Assistant Engineer under Commissioner of Public Works Gen. Fitz-John Porter. In 1880, he became Chief Engineer of the Department of Public Works under Allen Campbell, but the next year, under a new commissioner, he again became First Assistant Engineer. In 1885, he was made Chief Engineer of the Croton Aqueduct, which position he held until 1898, when he became Chief Engineer of the Department of Water Supply, and since 1902, Consulting Engineer for the same department. He was thus connected with water-supply development of the city for nearly 40 years.

John Edward Schwitzer, M. Am. Soc. C. E., Chief Engineer of the Canadian Pacific Ry., died in Montreal, Que., on Jan. 23, from pneumonia. He was taken to the Royal Victoria Hospital just a week before apparently suffering from typhoid fever. On Wednesday it was decided that he had pneumonia, but at that time his condition was not considered serious. He was born on April 19, 1870 at Ottawa, Ont. He graduated from Mcgill University in 1891 from the course in civil engineering. The same year he became a rodman and soon Assistant Engineer on the location and construction of the Ottawa & Gatineau Ry. From 1892 to 1899 he was connected with several different railways and spent two years in private practice. In 1899 he was first employed by the Canadian Pacific Ry. as Assistant Engineer in charge of the terminal improvements at Rat Portage, Ont. The following year he was made Assistant Engineer of Maintenance-of-Way at Winnipeg; the next year, 1901, he became Resident Engineer at the same city. In 1903 he became Division Engineer of the Central Division at Winnipeg, and two years later Principal Assistant Engineer of the Western Lines of the Canadian Pacific System. But three weeks ago Mr. Schwitzer had been promoted to the head of the entire Canadian Pacific system, as Chief Engineer. He was a member of the Canadian Society of Civil Engineers and President of the Winnipeg Society of Engineers.

Engineering Societies.

COMING MEETINGS.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION.
Feb. 6-11. Annual convention at Louisville, Ky. Secy., T. A. Randall, Indianapolis, Ind.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
Feb. 15. Annual meeting at Boston, Mass. Secy., N. W. Gifford, 26 Central Square, East Boston, Mass.

IOWA ENGINEERING SOCIETY.
Feb. 15-17. Annual meeting at Des Moines, Iowa. Secy., S. M. Woodward, Iowa City, Iowa.

NORTHWESTERN CEMENT PRODUCTS ASSOCIATION.
Feb. 28-March 1. Annual convention at Minneapolis, Minn. Secy., Harvey B. Smith, 834 Security Bank Bldg., Minneapolis, Minn.

CANADIAN MINING INSTITUTE.
March 1-3. Annual meeting at Quebec, Que. Secy., H. Mortimer Lamb, Windsor Hotel, Montreal, Que.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.
March 6-11. Annual convention at Toronto, Ont. Secy., Wm. Snath, 57 Adelaide St., East Toronto, Ont.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.
March 21-23. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At a meeting of the electrical section in Montreal, Jan. 19, Mr. A. O. Austin presented a paper entitled "The Development of Efficiency in High Tension Transmsision Insulators."

NEW YORK ELECTRICAL SOCIETY.—At the meeting in New York City, Jan. 18, Mr. David B. Rushmore, of Schenectady, N. Y., lectured on "Engineering on the Panama Canal." Mr. Rushmore has recently returned from a trip to Panama.

ENGINEERS CLUB OF ST. LOUIS.—A joint meeting with the St. Louis section of the American Institute of Electrical Engineers was held Jan. 18. Mr. Joseph A. Osborn presented a paper on "Motor Drive in the Steel Plant of the American Car and Foundry Co."

PACIFIC NORTHWEST SOCIETY OF ENGINEERS.—At the annual meeting, Jan. 7, officers were elected as follows: President, Arthur H. Dimock, Seattle, Wash.; Vice-Presidents, C. Edward Magnusson, R. H. Ober and A. O. Powell; Treasurer, Wendell N. Chase; Secretary, Joseph Jacobs, 803 Central Bldg., Seattle, Wash.

CENTRAL ELECTRIC RAILWAY ASSOCIATION.—At the closing session of the annual meeting in Indianapolis, Ind., Jan. 19, officers were elected as follows: President, E. B. Peck, Indianapolis; Vice-Presidents, W. S. Whitney, Springfield, Ohio, and A. W. Brady, Anderson, Ind.; Secretary-Treasurer, A. L. Neereamer, Indianapolis, Ind.

INSTITUTE OF OPERATING ENGINEERS.—The first of the regular monthly meetings of this recently organized society will be held at the Engineering Societies Building, New York City, Feb. 9, 1911. Mr. F. H. Sykes and Mr. C. H. A. Bjerregaard will speak on industrial education. Future meetings are to be held on the second Thursday of each month. The secretary is Mr. M. W. Rice, 29 West 39th St., New York City.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—At the meeting of the executive committee on Jan. 12, it was voted to hold the next annual convention in New York City, May 29-June 3, with four days of business sessions. No exhibition will be held this year in connection with the convention. The business sessions are to be held at the Engineering Societies Bldg. The membership of the Association now numbers 6,500 and an attendance of 3,000 is expected.

WESTERN SOCIETY OF ENGINEERS.—The officers for 1911 are as follows, and all are located at Chicago, with the exception of Prof. I. O. Baker, of the University of Illinois (Urbana, Ill.): President, O. P. Chamberlain, (Engineer, Union Paving Co.); Vice-Presidents, W. C. Armstrong (Terminal Engineer, C. & N. Y. Ry.); C. R. Dart (Bridge Engineer, Sanitary District); I. O. Baker (Professor of Civil Engineering, University of Illinois); Treasurer, A. Reichmann (American Bridge Co.); Secretary, J. H. Warder, 1735 Monadnock Block, Chicago.

MAINE SOCIETY OF CIVIL ENGINEERS.—An organization under this name was effected Jan. 17 at Augusta, Me., and officers were elected as follows: President, Cyrus C. Babb, Augusta; Vice-President, Walter H. Sawyer, Lewiston; Secretary, F. E. Pressey, Bangor; Treasurer, H. S. Boardman, Orono; Directors, Paul D. Sargent, Machias; E. C. Jordan, Portland; P. H. Coombs, Bangor; E. E. Greenwood, Skowhegan, and Moses Burpee, Houlton. The avowed object of the society is "the professional improvement of its members, the encouragement of intercourse among engineers and men of practical science, and the advancement of engineering."

OHIO ELECTRIC LIGHT ASSOCIATION.—The annual mid-winter meeting of the executive committee was held at Columbus, Ohio, Jan. 11. Cedar Point was selected as the place for the next annual convention, to be held July 25-28. The preliminary program of papers to be presented is as follows: "Ornamental Street Lighting," "Systematic Central Station Records," "Mercury Arc Rectifiers," "Motor-Driven Refrigeration," "The Development of the Central Station in Small Cities," "Pumping Water for Municipalities and for Irrigation by Electricity," "The Use of Tungsten Lamps in Sign and Outline Lighting," Committee Reports on Meters, Motor Applications, Electrical Transmission, and on Fire and Liability Insurance. The secretary is Mr. D. L. Gaskill, Greenville, Ohio.

MIDDLE WEST CLAY CONVENTION.—The 33rd annual meeting was held at the Palmer House, Chicago, on Jan. 17, 18 and 19, under the auspices of the Illinois Clay Manufacturers' Association. Several of the papers were of a technical character, while others related to manufacturing and business matters. Prof. A. V. Bleininger presented a paper on the work of the ceramic department of the University of Illinois; also one on "The Funnel Kiln," showing the methods employed abroad and their possible application to conditions in this country. Other papers included "The Center-Stack Down-Draft Kiln," by E. T. Montgomery (Urbana, Ill.), and "The Coal-Fired Continuous Kiln," by F. S. Naugle (Bucyrus, Ohio). A paper on "Drainage Investigations," by Mr. C. G. Elliott, M. Am. Soc. C. E., reviewed the work which is being carried on by the U. S. Government in regard to the reclamation of wet lands, and the relation of this work to the drain-tile industry. In regard to the tile drainage of uplands, a speaker pointed out that there were two opposite theories: (1) that it caused flooding of the lowlands by the rapid run-off, and (2) that the drained upland is in condition to absorb and hold water so that there will not be a rapid run-off. Mr. Elliott was inclined to the latter theory. A paper on "Sub-Irrigation," by Mr. D. H. Anderson (Chicago), suggested the tiling of dry ground for local irrigation as a promising development for the tile industry.